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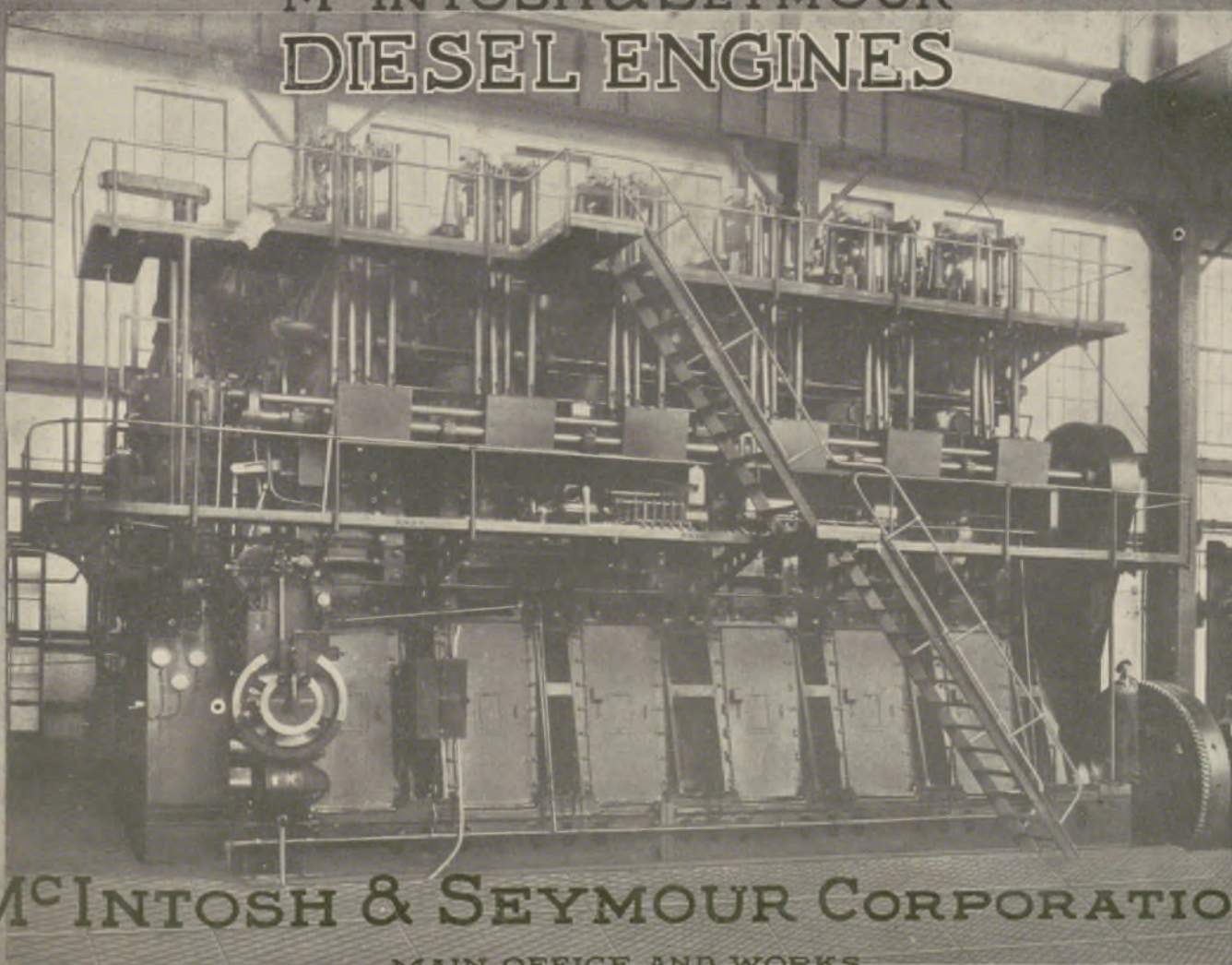
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JUNE, 1924

McINTOSH & SEYMOUR
DIESEL ENGINES



McINTOSH & SEYMOUR CORPORATION

MAIN OFFICE AND WORKS
AUBURN, NEW YORK, U. S. A.

Volume IX, No. 6

Price, 25 Cents

EXCLUSIVE technical and non-technical articles on design, construction and operation of oil-engines and motorships by the world's foremost writers on marine engineering.

Motorship

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Vol. IX

New York, U. S. A., June, 1924
(Cable Address—Motorship, New York)

No. 6

U. S. Senate Unanimously Passes Dieselization Bill

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 11 of the Merchant Marine Act, 1920, be, and the same is hereby, amended to read as follows:

"SEC. 11. (a) That during a period of five years from the enactment of this Act (Merchant Marine Act of 1920) the board may annually set aside out of the revenues from sales and operations a sum not exceeding \$25,000,000, to be known as its construction loan fund. The board may use such fund to the extent it thinks proper, upon such terms as the board may prescribe, in making loans to aid persons citizens of the United States in the construction by them in private shipyards or navy yards of the United States of vessels of the best and most efficient type for the establishment or maintenance of service on lines deemed desirable or necessary by the board, provided such vessels shall be fitted and equipped with the most modern, the most efficient, and the most economical engines, machinery and commercial appliances or, in the outfitting and equipment by them in private shipyards or navy yards of the United States of vessels already built, with engines, machinery and commercial appliances of the type and kind mentioned.

"(b) The term 'vessel' or 'vessels,' where used in this section, shall be construed to mean a vessel or vessels to aid in whose construction or equipment a loan is made from the construction loan fund of the board. All such vessels shall be documented under the laws of the United States and shall remain documented under such laws for not less than five years from the date the loan is made; and, so long as there remains due the United States any principal or interest on account of such loan.

"(c) No loan shall be made for a longer time than fifteen years. If it is not to be repaid within two years from the date when the first advance on the loan is made by the board, the principal shall be payable in installments to be definitely prescribed in the instruments. Such installments shall be made payable at intervals not exceeding two years; and in amounts not less than 6 per centum of the original amount of the loan, if the installments are payable at intervals of one year or less; and in amounts not less than 12 per centum of the original amount of the loan, if the installments are at intervals exceeding one year in length. The loan may be paid at any time, on thirty days written notice to the board, with interest computed to date of payment.

"(d) All such loans shall bear interest at rates to be fixed by the board, payable not less frequently than annually. During any interest period in which the vessel is operated exclusively in coastwise trade, or is inactive, the rate of interest shall be not less than 5¼ per centum per annum. During any interest period in which the vessel is operated in foreign trade, the rate shall be not less than 4¼ per centum per annum. The board may prescribe rules for determining the amount of interest payable under the provisions of this paragraph.

"(e) No loan shall be for a greater sum

Measure Goes to Conference, Where No Opposition Is Expected, and Then Will Be Ready for the President's Signature

than one-half the cost of the vessel or vessels to be constructed; or, than one-half the cost of the equipment hereinbefore authorized for a vessel already built: Provided, however, If sufficient and satisfactory security is furnished in addition to the mortgage on the vessel or vessels, the board may increase the amount loaned, but in no case shall the total loan be for a greater sum than two-thirds of the cost

ANOTHER step forward has been made towards the Dieselization Bill becoming law, it having been passed unanimously by the U. S. Senate following its successful passage in the House of Representatives. Very few changes were made by the Senate Committee on Commerce and in the Senate. We reproduce on this page the Bill as passed by the Senate. Of course, it goes to conference before being presented to the President for signature. No opposition is expected, and by the time this appears in print it will probably have been enacted.

of the vessel or vessels to be constructed; or, than two-thirds of the cost of the equipment, and its installation, for vessels already built.

"(f) The board shall require such security as it shall deem necessary to insure the completion of the construction or equipment of the vessel within a reasonable time and the repayment of the loan with interest; when the vessel is completed the security shall include a preferred mortgage on the vessel, complying with the provisions of section 30 of the Merchant Marine Act, 1920, which mortgage shall contain appropriate covenants and provisions to insure the proper physical maintenance of the vessel, and its protection against liens for taxes, penalties, claims, or liabilities of any kind whatever, which might impair the security for the debt. It shall also contain any other covenants and provisions the board may prescribe, including a provision for the summary maturing of the entire debt, for causes to be enumerated in the mortgage.

"(g) The board shall also require and the security furnished shall provide that the owner of the vessel shall keep the same insured against loss or damage by fire, and against marine risks and disasters, and against any and all other insurable risks the board specifies, with such insurance companies, associations or underwriters, and under such forms of policies, and to such an amount, as the board may pre-

scribe or approve; such insurance shall be made payable to the board and/or to the parties, as interest may appear. The board is authorized to enter into any agreement that it deems wise in respect to the payment and for the guarantee of premiums of insurance."

SEC. 2. That section 12 of the Merchant Marine Act, 1920, be, and the same is hereby, amended by adding at the end thereof a new paragraph to read as follows:

"The term 'reconditioned' as used in this section includes the substitution of the most modern, most efficient, and most economical types of internal-combustion engines as the main propulsive power of vessels. Should the board have any such engines built in the United States and installed, in private shipyards or navy yards of the United States, in one or more merchant vessels owned by the United States, and the cost to the board of such installation exceeds the amount of funds otherwise available to it for that use, the board may transfer to its fund from which expenditures under this section may be paid, from its construction loan fund authorized by section 11 of the Merchant Marine Act, 1920, so much as in its judgment may be necessary to meet obligations under contracts for such installation; and the Treasurer of the United States shall, at the request of the board, make the transfer accordingly: Provided, That the total amount hereafter expended by the board for this purpose shall not in the aggregate exceed \$25,000,000. Any such vessel hereafter so equipped by the board under the provisions of this section shall not be sold for a period of five years from the date the installation thereof is completed, unless it is sold for a price not less than the cost of the installation thereof and of any other work of reconditioning done at the same time plus an amount not less than \$10 for each dead-weight ton of the vessel as computed before such reconditioning thereof is commenced. The date of the completion of such installation and the amount of the deadweight tonnage of the vessel shall be fixed by the board: Provided further, That in fixing the minimum price at which the vessel may thus be sold the board may deduct from the aggregate amount above prescribed 5 per centum thereof per annum from the date of the installation to the date of sale as depreciation: And provided further, That no part of such fund shall be expended upon the reconditioning of any vessel unless the board shall have first made a binding contract for a satisfactory sale of such vessel in accordance with the provisions of this Act, or for the charter or lease of such vessels for a period of not less than five years by a capable, solvent operator; or unless the board is prepared and intends to directly put such vessel in operation immediately upon completion. Such vessel, in any of the enumerated instances, shall be documented under the laws of the United States and shall remain documented under such laws for a period of not less than five years from the date of the completion of the installation, and during such period it shall be operated only on voyages which are not exclusively coastwise."

Like Phoenix Arising From the Ashes

AFTER completing her maiden voyage to New York on April 30th, the motor-tanker ZOROASTER passed the Narrows and cast anchor in lower New York Bay. She was built by the Götaverken of Göteborg, Sweden, to the order of Consul-General Karl W. Hagelin and is intended to go into service of the Zoroaster Shipping Company to trade principally between the United States and European ports.

Particular interest attaches to this ship because her engines are a product of one of the pioneer European firms which took up the construction of Diesel engines in Russia on a large scale in the very same year that Dr. Rudolph Diesel's invention was carried out in its first commercial application. This was in the autumn of 1897 and license arrangements were completed by L. Nobel, Ltd., then of Petrograd. This action was due largely to the discernment of Anton Carlsund, at that time the Swedish chief-engineer of this firm,—and now a director of the new Swedish Nobel Diesel Co.—who appreciated the great possibilities of the new prime mover in view of the extensive crude-oil industry which is fostered in Russia by almost limitless deposits of the liquid fuel.

Subsequent developments were largely due to the personal interest of Ludwig Nobel, and to his brother Emanuel Nobel—head of the great Nobel oil company. When in Stockholm and Nynasham last year we had the pleasure of meeting all these interesting Diesel pioneers, as well as seeing their new big engine on the test-bed. The story of how the Red revolution in Russia cost them their vast oil wells, their pipelines, their beautiful homes, their yachts, their Diesel Works, and their great fleet of motorships and steamers brought a lump to our throat when Ludwig Nobel in a voice that gradually choked with emotion recounted their experiences.

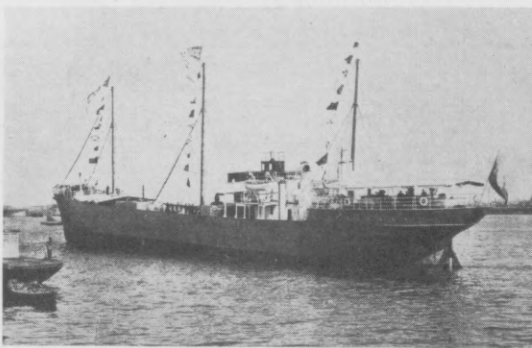
Nobels had just started on the greatest ship conversion program ever attempted when the revolution occurred, namely the changing from steam to Diesel power of a fleet aggregating 700,000 tons, which would have given them a total motorship marine of about a million tons. That Nobels should have started Diesel engine building in Sweden after this heart-breaking disaster, not only indicates the intense fascination in oil-engine development, but demonstrates stamina and courage worthy of record in history.

There were other European firms both in England and on the continent which took up Diesel engine manufacture shortly after the first commercial machine was produced, but there are few which pushed the development as actively and on as large a scale as did the Nobel Works.

In view of the wide scope of the pioneering work done by this firm, it is a paradox that so little should be known about their early accomplishments. For one thing, the

Driven Out of Russia by the Bolsheviks, Nobels, Diesel Engine Pioneers, Carry On in Sweden. ZOROASTER, a Tanker Driven by Their First New Engine, Arrives in New York

German engines at that stage of the development could run only on kerosene and the Swedish-Russian engineers found themselves confronted with the problem of re-making the license designs in such a way as



The first motorship "Zoroaster," built in 1911. She had twin b.h.p. Nobel Diesel engines, constructed under license by the Kolomna Co.

to render them suitable for burning what is commonly known as fuel-oil.

Nor is it generally known that the introduction of the multi-stage injection-air compressor was made essentially as the result of the efforts of the Swedish engineers in Russia at the time when Dr. Diesel and his associates were insisting either on the single-stage high-pressure compressor or on the cylinder by-passing device for securing a supply of injection air. Both the single-stage pump and the by-passing arrangement quickly had to give up when it had been demonstrated at Petrograd that a separately driven independent two-stage compressor of normal design could be attached to the engine in such a way as to form an entirely reliable operating unit.



Bow-view of the new "Zoroaster" riding at anchor off Staten Island, N. Y.

Dr. Diesel always had a prejudice against the compressor, which was overcome largely as the result of the successful work done by the Nobel engineers.

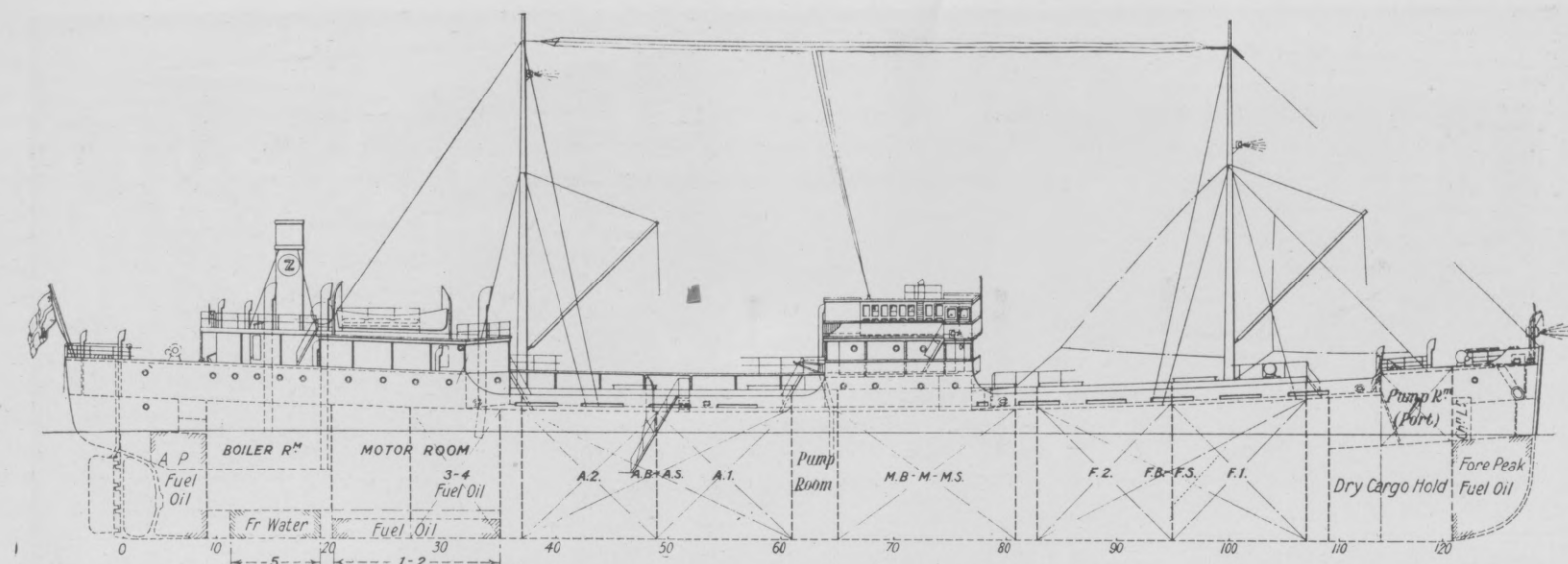
A complete account of the early development of the Nobel Diesel engine makes fascinating reading and we regret that it is beyond the scope of this journal to treat historical material at any great length. It may not be out of place, however, to mention the fact that there were installed at the steel rolling mill plant of the Moscow Metal Works in 1907, two 600-brake h. p. engines direct coupled to the mills. The unusually severe nature of this service is eloquent testimony of the rapid progress and staunch construction which these engines represented. An 800 h. p. six-cylinder, four-cycle engine having a bore of 23-5/8" and a stroke of 31 1/2" was installed at the Tzaritzin flour mill, a type of service characterized by the fact that any stoppage meant enormous losses to the millers. Owing to the fact that partially milled grain could not be continued in the process after a stoppage and had to be milled all over again from the beginning, it is apparent that the Diesel engine must have been thoroughly reliable to have been selected for this service.

Replacing steam engines in paddle-wheel tugs on the Volga river by means of Diesel engines was among the earlier achievements of the Nobel firm in the marine field and required the exercise of no small amount of ingenuity. It was the need for a light, high-speed engine suitable for reduction-gear drive that first led to the design of this type.

In 1907 such an engine was already on the test bed at the Nobel works and developed 120 b.h.p. in three cylinders at 400 r.p.m. with cylinder dimensions of 10-13/16" x 11-13/16". Several features were on it which have since become more or less standard on a wide variety of designs subsequently developed in all parts of the world. Just as Augsburg's adaptation of the vertical gas engine A-frame to the first Diesel engine still persists in recent construction, so Nobel's box-frame for their first light-weight high-speed engine may be considered as one of the prototypes of this class as generally manufactured today.

But the greatest historical interest attached to the Nobel four-cycle high-speed engine of 1907 was the fact that it was the first machine of this kind capable of being directly reversed. Nothing of the sort had ever been built anywhere else in the world before and hundreds of motorships sailing the seas today give testimony to the soundness of the engineering judgment responsible for the introduction of what must have been a daring innovation in 1907.

As in all new developments and inventions, it is difficult and not very useful to attempt to fix the exact priority of a firm or individual in the first applications of the new idea, and the truth of the matter generally is that several undertakings get



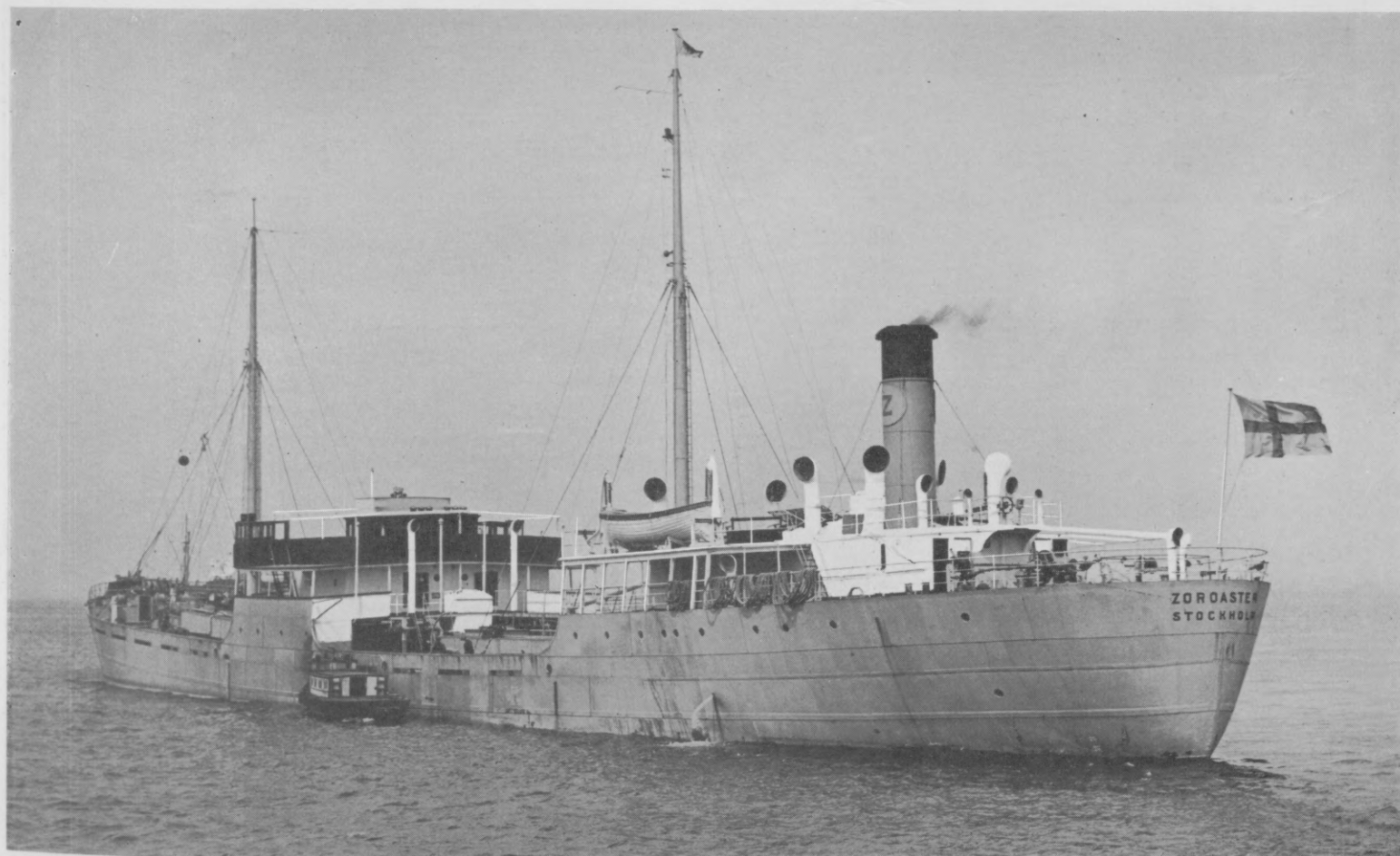
Longitudinal section of motor-tanker "Zoroaster." Her single Nobel engine develops 1,600 shaft h.p. in four cylinders at 105 r.p.m.

started simultaneously or at least independently of one another. As far as we know there was only one predecessor for a marine installation completed in 1904 by the Nobel Works, and that was an entirely abnormal design of grasshopper engine used on a canal barge in France. The freakish nature of this installation precluded any possibility of its ever being rated as a bona fide marine undertaking so that virtually the motorship SSARMAT, belonging to the Nobel Bros. Petroleum Production Company, may at least be considered among the claimants to the honor of mounting the first Diesel engine to be used for ship propulsion. It was a ship of 800 tons d.w.c. propelled by twin four-cylinder, trunk-

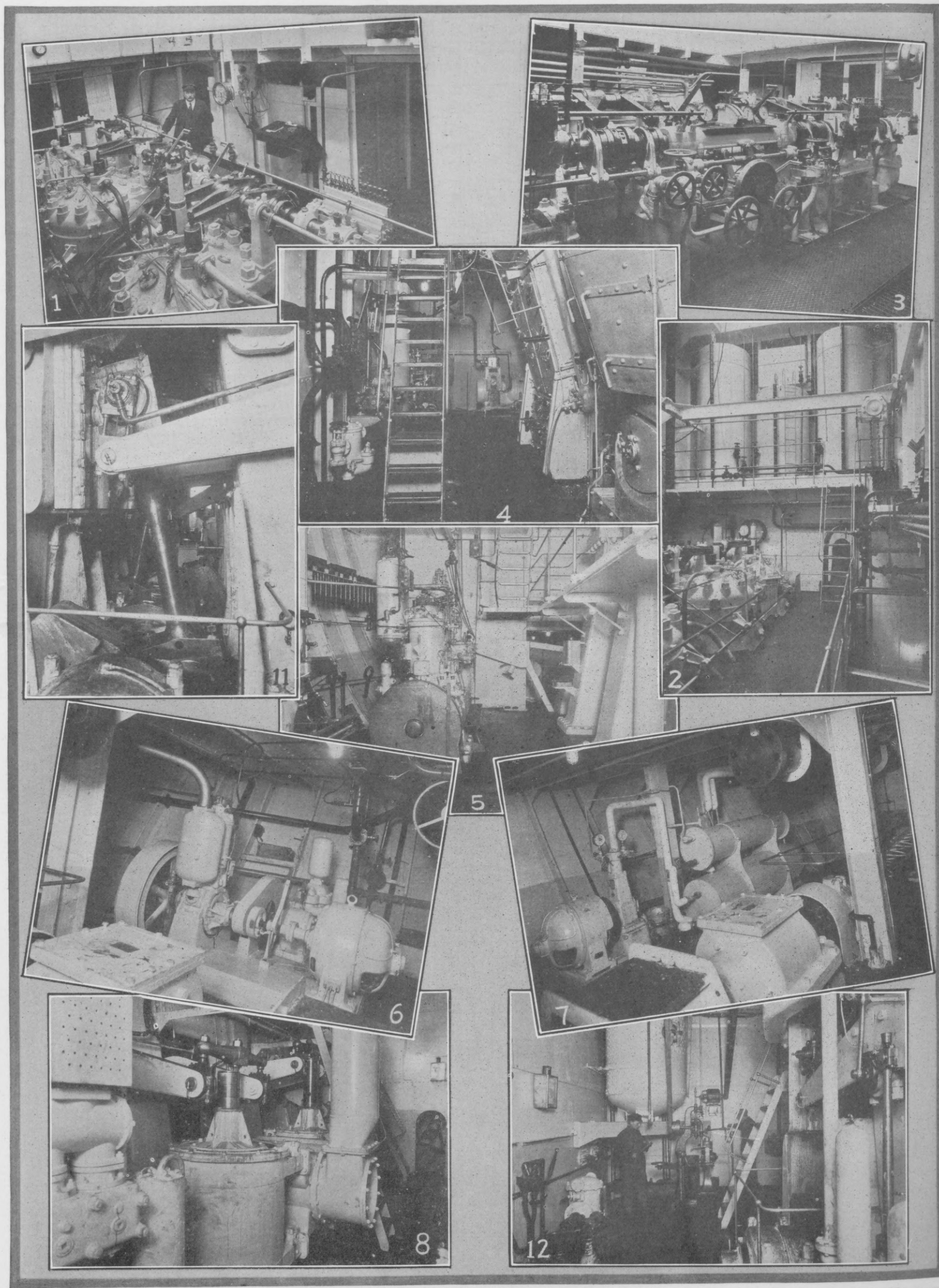
piston engines rated to develop 180 b.h.p. at 204 r.p.m. on cylinder dimensions of 12 $\frac{5}{8}$ in. by 16-9/16 in. These engines have been in commission for nineteen years, and are believed to be still in service in a power plant, the hull having become unfit for service.

Nor was the Nobel firm behindhand in the important work of applying Diesel engines to submarine propulsion, which they did in the case of the SSOM, the MAKREL, and many more submarine boats of these and other classes from 50 to 2,000 b.h.p. So we could fill many pages with the records of the excellent work turned out by these pioneers, such as a fleet of Diesel and Diesel-electric gunboats, and there can be no doubt that if

curves were to be plotted showing Diesel engine construction in all the countries of the world from 1897 on, the total horsepower delivered from Russian factories under Swedish direction would make a remarkable showing as compared with those of countries commonly supposed to be leaders in industrial and scientific developments. Over six hundred stationary Diesel engines and eighty-two motor-vessels were turned out by this concern prior to 1917. So great was the demand for the product of the Nobel Works that the capacity of their plant was soon exceeded by the orders, and license arrangements were made by the Kolomna Works in Golutwin. Although it may not be generally realized,



Swedish-Nobel tanker weighs anchor for demonstration run in New York harbor with party of visitors on board. Good maneuvering and smooth running were features of the trip

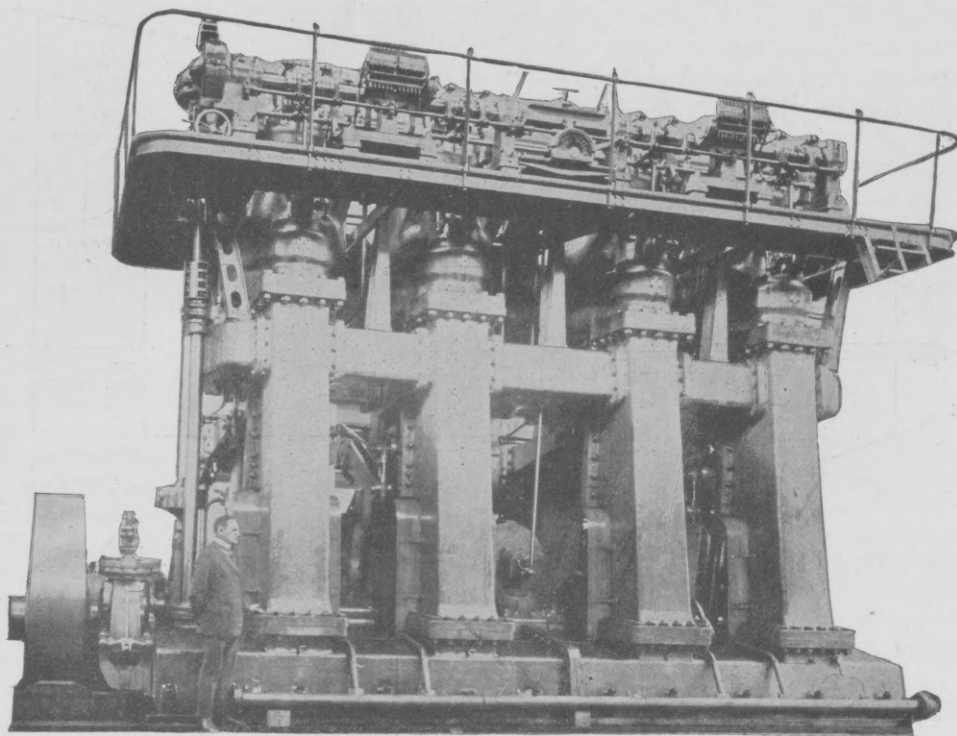


"Zoroaster's" engine-room: 1. Upper grating with chief-engineer next to telegraph. 3. Maneuvering controls on upper grating. No servo-motor is necessary. 4. B. & W. water-tube boilers to furnish steam for heating cargo. 11. Wide-open frame-construction gives easy access to moving parts. 5. Surface-ignition-engined auxiliary high-pressure air-compressor. 2. Daily-service tanks and travelling crane above cylinders. 6. Small surface-ignition drives lighting dynamo and bilge-pump for port use. 7. Refrigerating outfit. 8. Close-up view of beam-driven scavengers. Note simple and compact crosshead construction. 12. Starting tank and centrifugal purifier

the outbreak of internal troubles in Russia which occurred during the World War was the setback for Diesel engine undertakings of the entire world.

The Nobel Works after the war continued their work on a smaller scale at their new plant at Nynashamn, Sweden. They have kept pace with the latest developments in Diesel engine and surface-ignition designs, have introduced modern factory methods in the construction of their engines, and are maintaining that high standard of mechanical workmanship which has always characterized Sweden as the home of the machine industry.

One of the first products of the firm, after it had been successfully re-established at Nynashamn, was the engine of the motorship ZOROASTER referred to at the beginning of this article and visited by a company of American Diesel-engine builders and persons interested in shipping on April 30th. The invitation was courteously given by Boris Hagelin, son of K. W. Hagelin, a director of the Nobel Oil Company, Mr. Hagelin representing both the shipowners and engine builders. Before starting out on her maiden voyage this ship had run successful trials on March 19th at



The "Zoroaster's" 1,600 shaft horsepower two-cycle Diesel engine, speed 105 r.p.m. Mechanical efficiency 81%. Fuel consumption 0.39 lb. per s.h.p. hour. Length 26' 6"

the entrance of the harbor of Gothenburg between the points of Vinga and Torrbos-

kar, at the conclusion of which she was turned over to her new owners. Although an average speed of 12.6 knots was realized, a maximum of 13½ knots was shown to be obtainable without difficulty.

Conforming to the specifications of the British Corporation Class B.S. and being built in accordance with the Foster-King system, this vessel represents one of the latest developments in tankship design. Her principal dimensions are as follows:

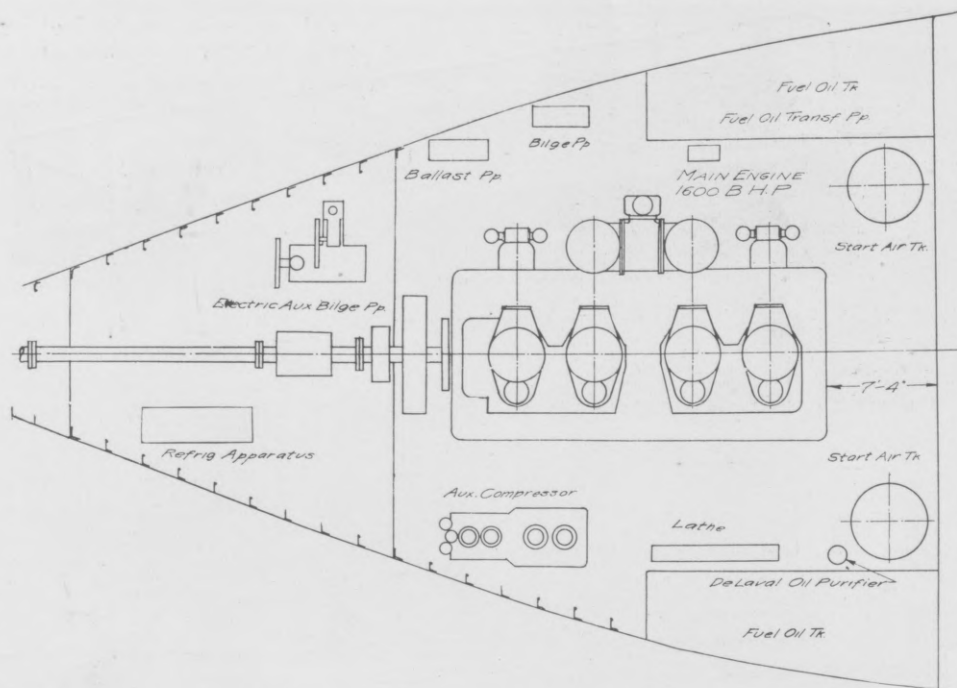
Total cubic capacity of cargo tanks	221,000 cu. ft.
Total capacity of tanks for fuel-oil (double bottom bunkers, tanks at sides of engine-room and in the fore and after peak)	414 tons oil of a specific gravity of 0.872.
Deadweight capacity	5,100 tons.
Power	1,600 s.h.p.
Power	2,000 i.h.p.
Ship's speed, designed	11½ knots.
Cylinder bore	29 9/16"
Piston stroke	36¼"
Engine speed	105 r.p.m.
Length o.a.	323' 0"
Length b.p.	309' 8½"
Breadth moulded	49' 0"
Depth moulded to main deck	28' 0"
Loaded draught, mean	22' 4"
Propeller (material, Parsons Manganese Bronze), 4 blades, diameter, 14 ft. ¾ in.; pitch, 12 ft. 3 in.	

In view of what has already been said about the Nobel Works, the main interest in this ship centers in her 1,600 b.h.p. Nobel Diesel engines, which are of the two-cycle, single-acting crosshead type turning at 105 r.p.m. A complete description with tests has already been published in *MOTORSHIP* for December, 1921.

Naturally, as soon as the party came on board the very first thought of all those present was to look at the engine-room, which indeed presented a scene such as to occupy the attention of anyone who had ever been concerned with the work of efficiently propelling ships. It was difficult at first to get one's bearings after looking at the short group of four cylinder-heads visi-



Visitors to the "Zoroaster" as she was about to set sail on her demonstration run. Boris Hagelin, representing her owners and the Swedish-Nobel Company in America, stands in the center of the group, in the second row back, with his left hand in his pocket. Representatives of American firms prominent in motorship and Diesel engine work witnessed the demonstration



Four cylinder arrangement produces short engine and allows peaked end of ship to be well utilized

ble at the top-grating. It seemed almost incredible that this short length of machinery (26 ft. 6 in.) should be capable of producing all that power, and should be so roomily accommodated in an engine-room considerably shorter than those commonly arranged for six-cylinder engines of smaller power. While the visitors were making their inspection, no work of any kind was going on in the engine-room and only some steam auxiliaries for pumping and lighting were in operation. Certainly no repairs were being made.

Suddenly, at the sound of the engine-room telegraph an engineer ran up and down the ladders once or twice and the next thing the visitors knew the engine had been started on air and was quickly switched over to run under its own power. It was evident that the maneuvering of this engine had been simplified and reduced to a routine so elementary that the operating crew had to worry about it very little.

Part of the striking simplicity of the engine-room work which was thus forcibly demonstrated is due to the fact that the main unit is entirely self-contained, having attached to it all the various pumps necessary for the circulation of cylinder and piston cooling water, the supply of scavenging air, and the charging of injection and starting air tanks. Although there has been manifested a tendency on the part of some marine engineers to strip the main engine of all direct-driven auxiliaries, the extraordinary demonstration on the ZOROASTER made everyone reflect that there are certainly two sides to the question of direct versus independently driven auxiliaries. With a type of engine-room administration which ensures that all the direct-driven auxiliaries will do what they are intended to do as soon as the main engine starts to run, there can be no doubt that this system makes for simplicity in maneuvering work which compares favorably with that of the independent auxiliary arrangement.

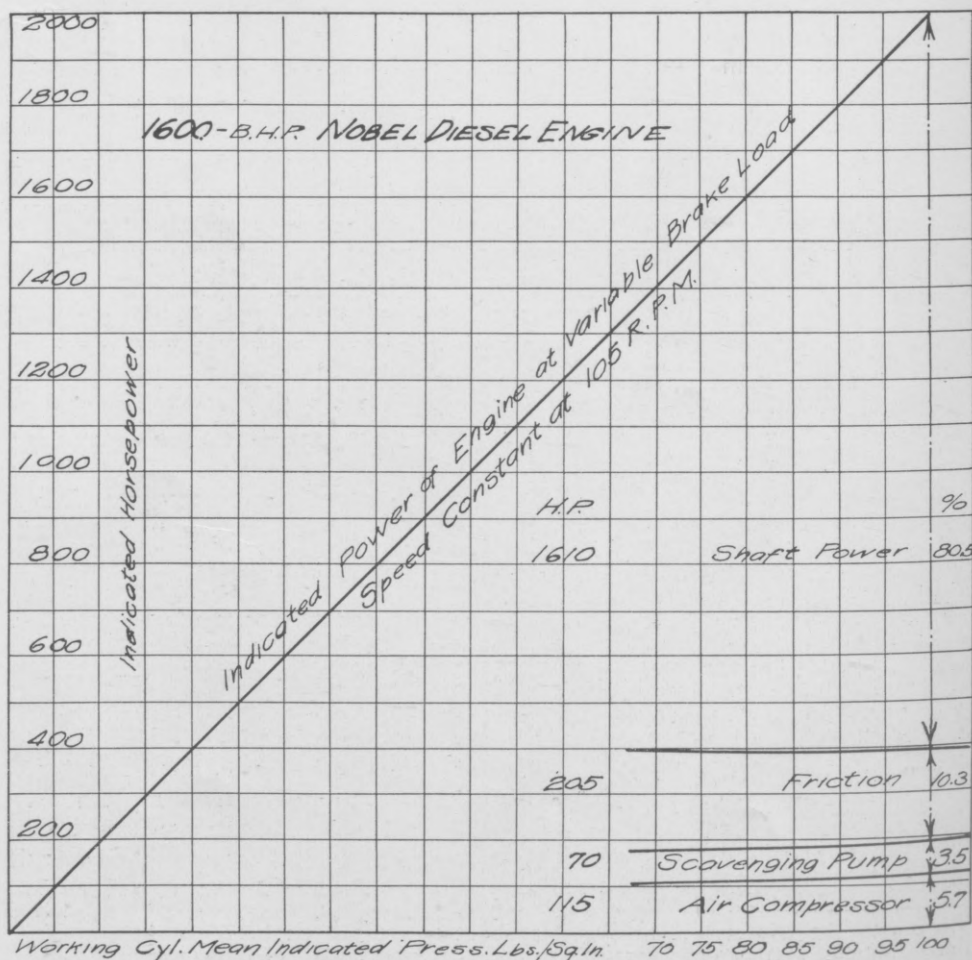
Beam drive is used for the scavenging pumps which hang downward and are fitted with cylindrical hollow trunk cross-heads of a simple and compact design. The trunk is in reality the piston-rod which enters the upper cylinder-head of the scavenging pump and contains a gudgeon connected to a link whose upper end is journaled to the outer end of the walking beam. The arrangement reduces side thrust to an indefinitely small amount and the surface made available by the trunk is many times

as great as what would be necessary for taking it up without wear or heating.

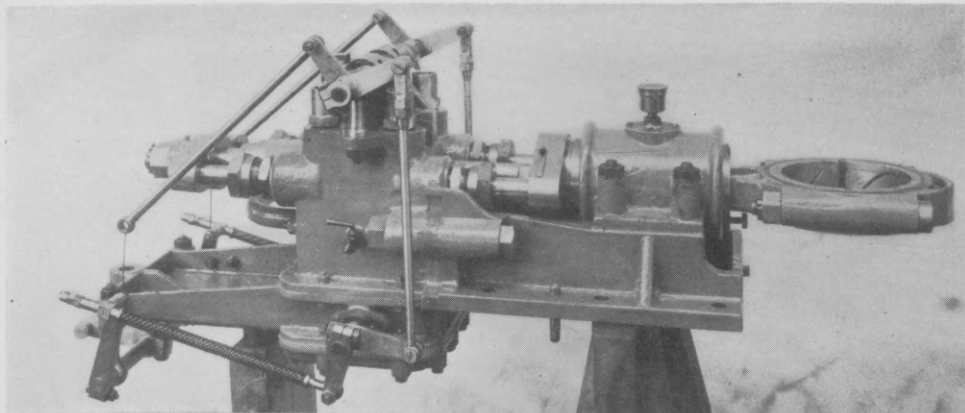
Plunger pumps with valve pockets accessibly located are also hung off the beams and it was a pleasure to note the promptness with which they began to pick up as soon as the engine had made its first turns. Starting this two-cycle engine is accomplished by the use of a pair of small valves located on the tops of the cylinder heads, one of which admits air at about 350 lbs. per sq. inch pressure and the other relieves compression during the starting period. Needless to say, neither of these valves are in commission once the engine has been switched over to fuel and after that only the central fuel valve is kept working. It was an eye-opener to the writer to note the promptness with which the engine began to fire and the economy in the use of starting air was so great that the attached air-compressor was able to maintain the starting-air pressure in spite of a long string of bells, most of which called for slow and half-speed running.

Credit is due also to the chief-engineer and his two assistants who displayed unusual dexterity in catching the engine on fuel after giving it only a kick or two with starting air. Outside of the chief and the first and second motormen, the engine-room contains six oilers and two donkey men, but after the first voyage only three oilers will be employed.

During the voyage from Göteborg to New York via the English Channel from April 9th to April 28th, which covered 450 hours sea time, 3,899 miles were covered



Power balance of "Zoroaster's" engine. With a speed of 105 r.p.m. and a brake load to give 2,000 i.h.p. at that speed, 115 h.p. go to the compressor, 70 to the scavengers, and 205 to friction, leaving 1,610 as useful h.p. on the shaft



Four-plunger pump of 1,600 b.h.p. engine has only exterior controls for engine-speed variation, hand-cut-out, and over-speed cut-out from governor

with the engine averaging 98 r.p.m. Unusual heavy weather, including four gales, was encountered and at times slowed the ship down to a speed of $1\frac{1}{2}$ knots. In the course of the voyage 100 tons of Texas Diesel oil were used, and 15 tons were consumed for heating and galley purposes.

Owing to the fact that no opportunity has been had for the fitting of a propeller of the right pitch, the full mean-indicated pressure of the engine is developed at 98 r.p.m. or seven turns less than the rated speed of 105 r.p.m. At a suitable opportunity a propeller of smaller pitch will no doubt be fitted, which will allow the engine to come up to speed and to develop its full power at a normal m.e.p.

Part of the striking impression made by the top view of the engine and already commented on, is due to the location there of the maneuvering stand, although there will always be engineers who prefer the bottom location and for whom the Nobel Company is ready to furnish it. There is a great deal to be said in favor of the top-grating arrangement. Everything which the maneuvering engineer needs to watch, and of this by far the most important part

is the valve gear and fuel pump, is located on top where needed corrections can quickly be made if they should become necessary while answering bells. In the case of a steam engine this condition is exactly reversed because the valve gear for steam cylinders is visible and accessible from underneath, whence the maneuvering engineer can also watch the major moving parts. Both in steam engines and Diesel engines the latter are hardly ever known to require attention nowadays while maneuvering, so that the logical choice of the location of the maneuvering platform depends essentially on the matter of supervising the valve gear. For steam engines it would therefore appear reasonable to put the controls below and for Diesel engines the right location may be chosen as the top grating.

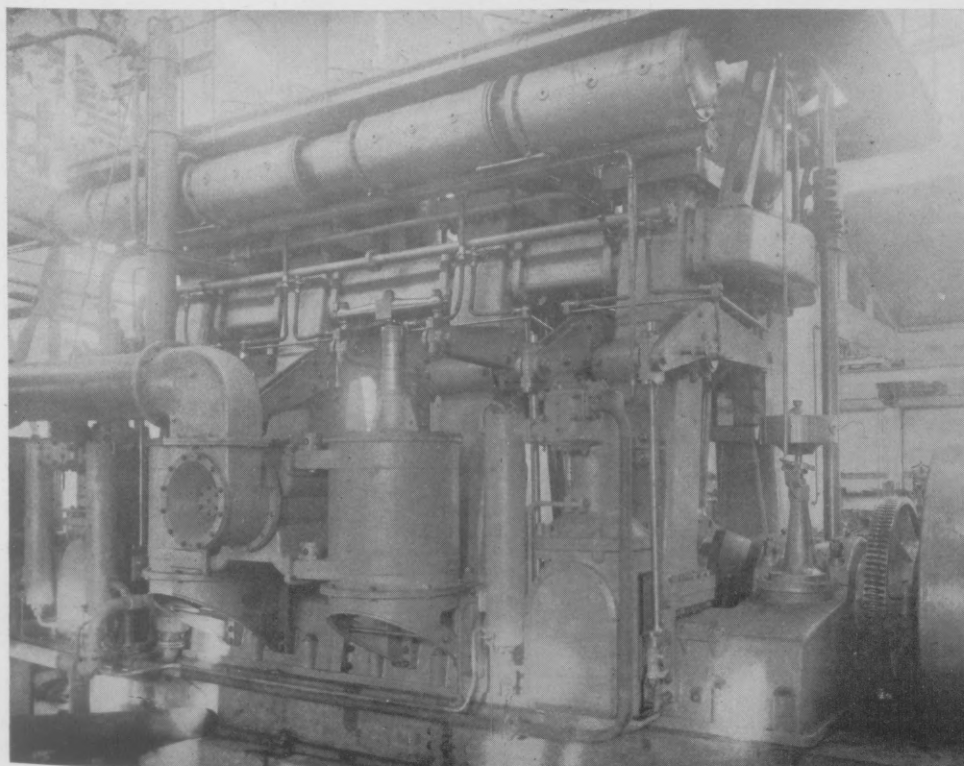
Of the many ways for setting up the framing of an engine there are few as simple and straightforward as that of using ordinary box-section columns for supporting the cylinders and mounting the cross-head guides, the arrangement adopted in the design of the Nobel engine. Flanging out the base of the cylinder jackets to

match the bolting flanges at the tops of the columns makes a firm bridgelike structure of the lower ends of the jackets, which are then easily proportioned to give the required strength. A good deal was formerly said and written about the advisability of transmitting the working load through cylinder jacket casting perforated for exhaust and inlet ports, but experience has shown that it is easy to dispose the available metal in such a way as to keep stress intensities far below anything which might offer the remotest possibility of danger.

Since a gib crosshead of the ordinary marine type is used in this design, only one column need be used to support the main crosshead slide and the astern gibs, with the result that the other column remains unencumbered. By stepping between the columns the engineer on watch can keep all the crosshead parts under direct observation and can at all times take whatever measures may be needed to keep them in good running order. This is a point on which marine engineers have laid great stress from the very first time when marine Diesel engine first began to be introduced and there can be little doubt that the ability of the watch engineer to keep his eye and hand on all moving parts is a big factor in maintaining the undisturbed operation of the engine.

One of the drawbacks formerly ascribed to the two-cycle engine was the use of complicated cylinder-head castings, but that is surely not applicable to the design under consideration. Modern foundry methods, and port scavenging, have relieved the two-cycle engine of this criticism. The cylinder of this particular type of two-cycle machine contains only three small openings, one for fuel, one for starting air, and one for compression relief. These three symmetrical openings can be easily disposed in such a way that they do not necessitate elaborate core work and result in a casting which can be easily poured and checked up later for soundness. In addition to that the Nobel cylinder heads are made of cast steel, a material which has stood the fire-test of submarine Diesel work better than any other.

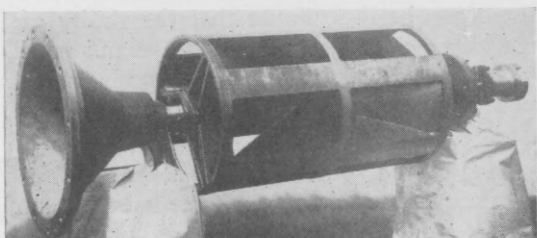
Valve control for port scavenging has made its appearance in a good many designs and is used because it permits of making the inlet ports as high as or higher than the exhaust openings. Without a valve, high scavenging ports would result in the passage of exhaust gases back into the inlet manifold; on the other hand high ports are of advantage to insure good filling of the cylinder with fresh air. Stress is laid on this feature of the Nobel design, but the use of high ports and a valve for supercharging purposes is not claimed. The object of the arrangement is simply to give the cylinder a full charge of fresh air since it has been the experience of the Nobel engineers that high scavenging air pressures such as would properly characterize real supercharging, has not improved the ordinary method of two-cycle operation.



Scavenging-pump side of "Zoroaster's" four-cylinder engine. Note massiveness of engine design combined with accessibility shown in frame construction

What the Nobel engineers claim as a real improvement is an automatic type of scavenging valve which requires no valve gear to drive it and is free from exterior moving parts. It consists of a set of light plate-valves resembling those used on compressors and blowing engines, and these lift automatically as soon as the pressure in the cylinder has fallen below that prevalent in the scavenging header. During the latter part of the down-stroke of the piston both inlet and exhaust ports are uncovered near or at the same time, as would follow from what has already been said about high inlet ports. Free exit is possible for the gases through the exhaust openings, but so long as there is pressure in the cylinder it will hold the plate valves down on their seats and the rush of gases into the scavenging manifold will be prevented. At the precise instant when the scavenging pressure can overcome the exhaust pressure, the flow of fresh air begins.

Quite aside from the very considerable simplification of the engine's valve gear which is brought about by this method, it



Single valve controls suction and discharge for both scavenging pumps

has consequences of importance from the point of view of scavenging efficiency. It must be borne in mind that the time available for the substitution of fresh air for exhaust gases is very short even in slow-speed engine since the entire process must be completed between the instants at which the edges of the ports are uncovered and covered again by the piston. According to common practise piston and ports come edge to edge at about 50° before and after dead center, making available a total of 100° of rotation for the scavenging operation. If the engine revolves at 100 r.p.m., the corresponding time interval is $\frac{100}{360} \times \frac{60}{100} = \frac{1}{6}$ of a second and only a part of this small fraction is devoted to inlet.

Now it has been found necessary for reasons of safety to time a mechanically operated valve so that it begins to open slightly later than the instant at which the exhaust gases have dropped to a pressure exactly equal to that of the scavenging air. This point varies with the load on the engine and occurs sooner or later depending upon the pressure in the cylinder at the moment of release. In the case of the mechanically operated valve it is necessary to delay opening until there can no longer be any doubt about the exhaust pressure being below the scavenging air pressure with the result that a certain amount of time which

can ill be spared is lost to the scavenging process.

Owing to the prompt action of the automatic valve, it always starts to scavenge at the moment the cylinder is ready for it and no matter what the pressure conditions at release may be, the automatic valve always accommodates itself. Strange as it may seem, the instant of pressure equalization occurs earlier at heavy loads than at light ones because the ejector action of the out-rushing gases is more intense at higher loads. Consequently the automatic valve begins to scavenge earlier at heavier loads and gives the cylinder more air as it is required. At low loads, conversely, less air is admitted, a consideration of importance from the point of view of economizing scavenging air while maneuvering at low speeds.

Objections to the automatic valve on the score of its being frail and exposed to injury from the hot exhaust gases have been found to be without substance because it is located virtually in a dead pocket during the short interval of time over which it is exposed to this action.

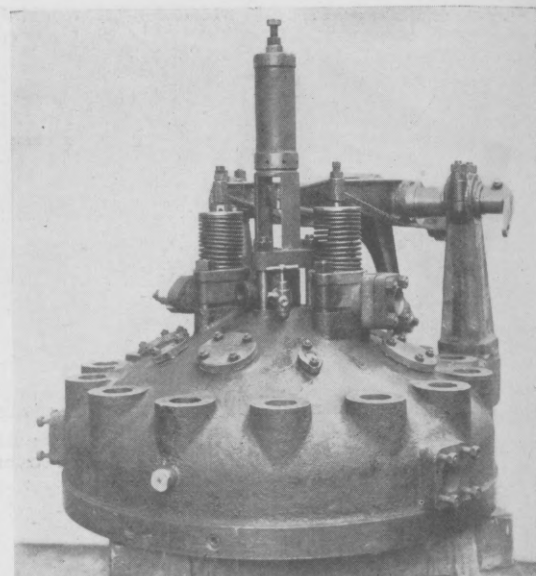
Although the design of engine under consideration is still equipped with mechanical scavenging valves, spares are provided on the ZOROASTER in the form of automatics, which have been designed to go into the cylinder pockets already fitted.

As a further means for making the main propelling machinery an absolutely self-contained unit, an extra auxiliary air-compressor has been placed on top of the intermediate pressure cylinder in the injection air compressor and supplies air at about 120 lbs. per square inch pressure for operating the steering engine and the air whistle. Even electric current for lighting purposes is furnished by the main engine to whose flywheel an 8 K.W. electric generator is belted. Fuel-oil transfer pumps and lubricating oil elevating pumps are driven by chains and sprockets from the main engine shafting.

Auxiliaries for port and emergency use have been made steam-driven for the reason that steam heating for the cargo tanks must be provided anyway. The low first cost of this machinery, and the fact that it is used only for a comparatively small fraction of the time in the course of which its extra fuel consumption plays no very great part, were among the determining factors in its choice.

Good use is made of the peaked space after the engine-room for accommodating a Babcock & Wilcox water-tube boiler having a heating surface of 1,360 sq. ft. and built to operate at a pressure of 130 lbs. per sq. inch. Standard fuel-oil burning equipment of the most up-to-date and complete type such as is used on main boilers of oil-fired steamships, has been provided for this installation, with due regard to the importance of getting even the most viscous of oil cargoes out of the ship promptly and without danger of interruption.

Exclusively for heating purposes a small Cochran boiler with 160 sq. ft. of heating

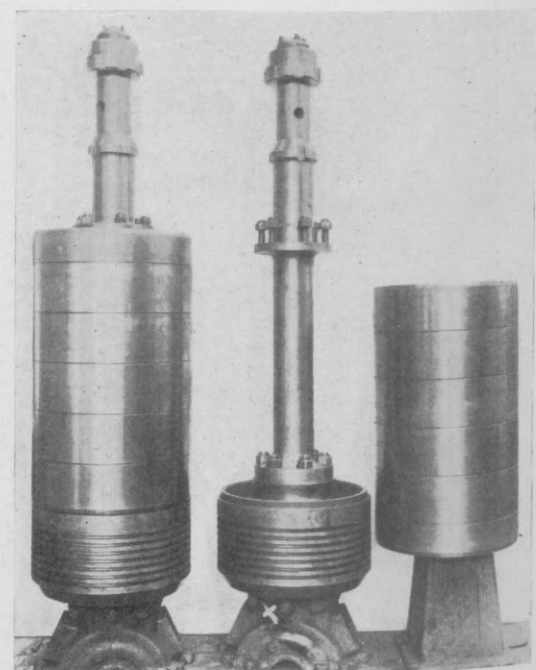


Cast-steel cylinder-head of "Zoroaster's" engine. The two valves on either side of the spray valve act only while starting

surface has been arranged next to the Babcock & Wilcox boiler. It is oil-fired according to the Kermode system of steam fuel atomization.

Steam-driven auxiliaries include three duplex pumps amidships, each having a capacity of 100 tons per hour; and one bilge pump capable of delivering 50 tons hourly. The arrangement of the piping is such that either of the cargo pumps can draw from or deliver to either of the main compartments of the ship and an additional bilge pump is arranged in the forward pump-room located in the forepeak of the ship.

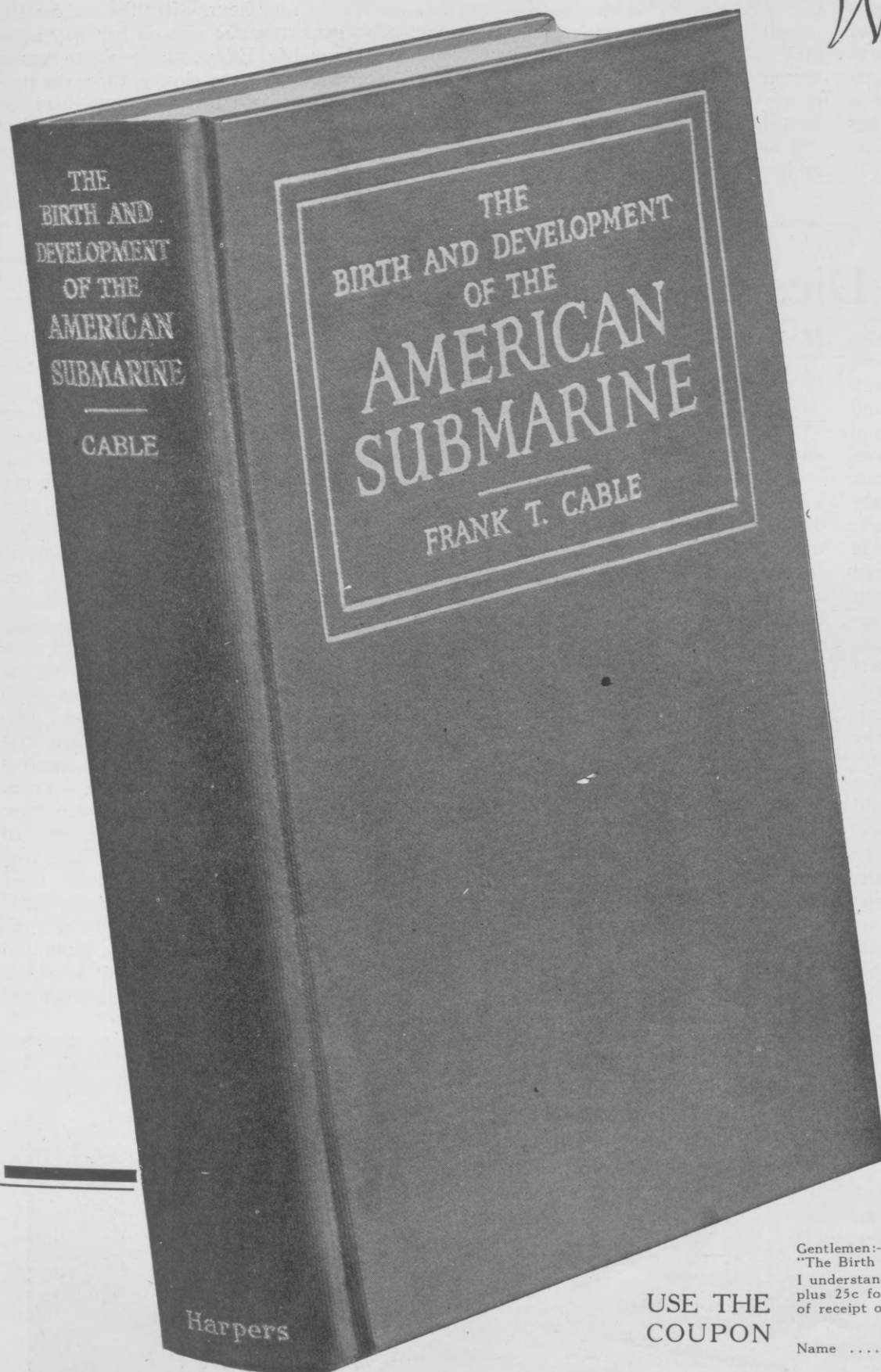
Two Worthington duplex steam pumps are located in the engine-room for bilge and ballast service while the engine is in port and for emergency use. The former has a capacity of 45 tons, while the latter can throw 60 tons per hour. Additional auxiliary power for lighting and for bilge and sanitary pumping is furnished by an oil-engine driven set to which an 8 K.W. lighting outfit and the pumps are connected by means of a friction clutch and spur



Water-cooled pistons and trunks of Nobel marine Diesel engine

A Mighty Interesting Book

This timely book is published to meet the demand in all countries of the world for accurate information regarding the future of the submarine and its direct effect upon the future of war and world peace.



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CAPTAIN FRANK T. CABLE, the editor of this remarkably interesting book, is the electrical engineer who helped to develop the original Holland Submarine, commanded her on every trip from the time she was completed until she was sold to the United States Government.

He superintended the completion, conducted the trials and trained the crews for the first submarines built by the English, Russian and Japanese Governments. He has spent nearly thirty years in the development, construction and operation of these undersea craft, and in connection with this work he has visited every country in the world that has adopted submarines.

Untechnically, but in a minute and entertaining detail CAPTAIN CABLE tells in this book the story of the crude early experiments in submarine building, dating from the early classic times, its modern mechanical developments, its introduction to naval builders and to the governments of nations.

It is a volume of 337 pages, profusely illustrated and entertainingly written by a man who thoroughly knows his subject.

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Gentlemen:—Please mail me a copy of Capt. Frank T. Cable's "The Birth and Development of the American Submarine." I understand that you will invoice me for this book at \$4.00 plus 25c for postage, and that I will remit within ten days of receipt of the volume.

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gears. The engine is a Gamma surface-ignition type and develops 20 h.p. at 40 r.p.m. It is a Nobel production, and is fitted with an American electric starting device (Nolte) which makes it possible to start in less than thirty seconds. A Michell-type thrust-bearing, manufactured at Götaverken, is located on the line shafting and is distinguished by the small space which it occupies.

On the starboard side of the engine-room an emergency air-compressor driven by a Gamma surface-ignition oil-engine of 100 b.h.p. at 200 r.p.m. is located. Twin three-stage air-compressor cylinders driven from the same crankshaft which belongs to the oil-engines, are capable of compressing 300 cu. ft. of free air per minute against a pressure of 800 lbs. per square inch.

An additional indication of the rapid pace at which installations of centrifugal oil-purifiers are spreading both in this country and abroad is furnished by the Swedish De Laval oil-purifier installed in this ship for the purification of lubricating oil before it is returned from the engine sump to the oil tanks. Irrespective of whether enclosed force-feed lubrication is employed or the gravity method used, care must be taken to prevent contamination of the lubricating oil. The way in which this has been accomplished by the centrifugal purifier shows that it is one of the most effective methods known for protecting a plant against lubricating difficulties. Forced lubrication is furnished to shipowners who prefer it.

A steering engine, driven either by steam or by compressed air furnished from the

main engine auxiliary compressor already mentioned, has been supplied by Aktiebolaget, Luth & Rosen of Stockholm, and the hydraulic telemotor for controlling the same is a product of Aktiegesellschaft Weser of Bremen. Good accommodations are provided for the officers and are arranged in the deckhouse below the bridge, while a light and airy dining room and staterooms for the engine-room staff are situated in the after deckhouse.

Within four hours after the visitors left the ZOROASTER, she was on her way again to Alexandria, Egypt. Last-minute reports received just before closing for press state that she has discharged her cargo there and is now on the return journey to the United States, being expected at New Orleans during the latter half of June.

Augsburg Diesels to Be Built at Hamilton

LAST summer while we were visiting the shipyards and oil-engine plants of Europe, studying the latest developments, George A. Rentschler, Jr., and Henrik Gregor, managing-director and chief-engineer respectively of The Hooven, Owens, Rentschler Co., Hamilton, Ohio, were over there similarly engaged, only with a different objective, and for the second time. Their task was to decide which Diesel engine of tried and proven design would best blend with their own engineering experiences and shop practices. After spending practically six months investigating the leading plants and engines, the summing up of the problem from every angle caused the decision to fall on the Diesel as built at the Augsburg Works of the Maschinenfabrik Augsburg, Nürnberg, of Germany. That their joint engineering experiences would form a tremendously powerful alliance, invaluable in manufacturing a Diesel to compete with any at present on the American market, was the conclusion formed. So a license was recently secured, and a start is about to be made on a pair of 1,500 s.h.p. merchantship type Diesels which, by the way, will be

*Hooven, Owens, Rentschler Company
Acquire License From Germany's
Oldest Oil-Engine Builders*

known as the Hamilton-M.A.N. engine.

Both marine and stationary engines will be constructed in slow-speed, medium-speed and high-speed types, although the shops at Hamilton are now so crowded with other engineering work it is very probable that oil-engine work will be somewhat limited so far as the remainder of this year is concerned to the aforementioned units, and their necessary auxiliaries. Furthermore, plans as previously made call for the building of the smaller models, such as ship's engine-room auxiliary sets and yacht engines, at the associated plant of C. & G. Cooper, Mt. Vernon, Ohio, this being covered by the license.

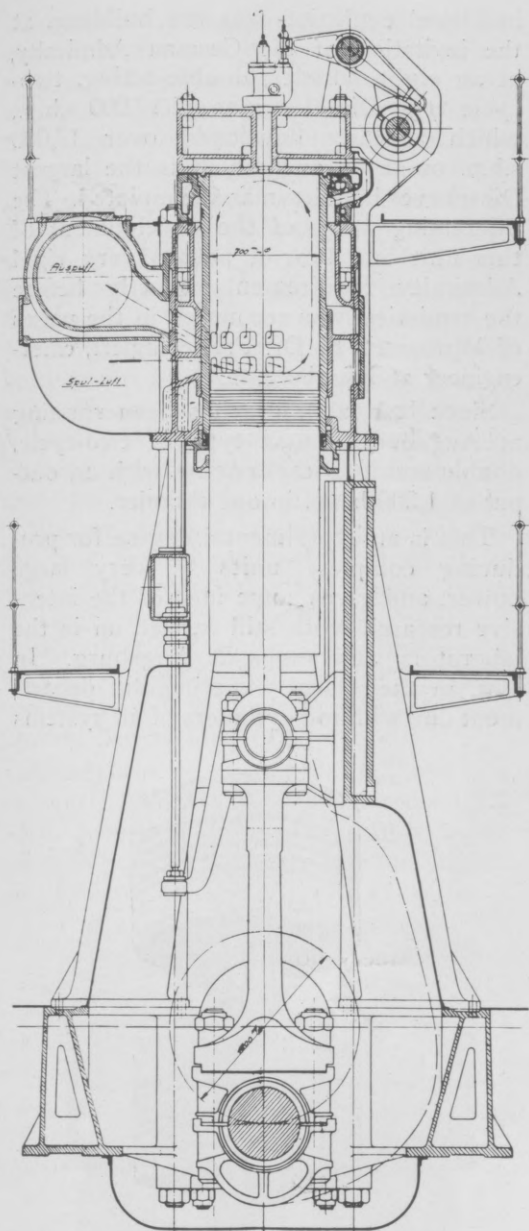
The Hooven, Owens, Rentschler Co. was established in 1845, and in some respects has had a development similar to that of the M. A. N., whose work we shall presently discuss, both companies being formed about the same time. In the beginning the Hamilton Company manufac-

tured saw-mill machinery, and then turned to Corliss engine work. Steam engines of all types for both land and marine purposes have been turned out and gas engines, sugar machinery, steam engines, plate glass equipment, rolling-mill machinery now almost clog the machine tools, if we may judge by the piles of castings grouped about the shops when recently at this plant, which is busily engaged with a variety of orders at the present time.

The Company's contribution to shipbuilding is too well known to need elaboration. During the war and post-war emergency they constructed four 2,800 i.h.p. steam engines a week for the Emergency Fleet Corporation in addition to a total of seventy-seven 1,400 i.h.p. steam engines and forty 750 i.h.p. steam engines. Some of these as high as 5,000 h.p. have been built for marine purposes. In fact shipbuilding returns of 1921 show that Hooven, Owens, Rentschler built more horsepower than any other single plant or shipyard in the world. Nineteen engines of 3,200 i.h.p. each were built that year for tankship purposes and now propel vessels in the fleets of the Standard



Bird's-eye view of the Hooven, Owens, Rentschler plant at Hamilton, Ohio, where the manufacture of Diesel engines according to license from a leading European firm is being taken up



Single-acting 1,500 s.h.p. two-cycle engine of M.A.N. design with loop scavenging. A start is being made on two of these engines at Hamilton

Oil Co. of New Jersey, the Standard Oil Co. of California, the Texas company, etc. A modest amount of oil-engine experimental work has been carried out on their own account, but not for commercial purposes.

Aside from the steam engines of seven tankers built in the United States for the Anglo-Saxon Petroleum Co. of London, another interesting engine is the quadruple-expansion set of 4,000 i.h.p. in the Southern Pacific Company's 16,000 tons tanker TAMIAHUA, and the quality of engineering exacted by this shipowning and railroad concern is well known in the industry. Many other vessels such as some owned by the Mallory Line, Merchants & Miners Transportation Co., and Wm. Wrigley Co., have steam engines built or building at Hamilton. In the stationary field there are over 5,000 Hamilton steam engines.

Because of all this marine and stationary engineering experience at their backs, the directors came to the conclusion that a close working alliance with European engineers who had spent their

lives studying and building Diesel engines, would result in a far more satisfactory engine and one more favorably adapted to American conditions than would be a Diesel engine of their own design. Also that a considerable amount of time and energy could be saved in this manner.

One reason why the H. O. R. Company have not previously taken up the construction of Diesel engines is that they realized that intense development would take place in Germany and other countries following the war, so they preferred to wait five years and let Europe do the developing and then secure the benefits of that experience without needlessly taking up the intervening time and the capacity of their own engineers and shops.

New machine tools are constantly being added to the Hamilton plant of the Hooven, Owens, Rentschler Company, among which are a number of special tools especially for Diesel engine construction. One unit, which is also for the general engineering work, is what is believed to be the heaviest and most powerful planer in the world. We give several illustrations of the shops and tools.

The present directorship of The Hooven, Owens, Rentschler Company is as follows:

Gordon S. Rentschler, Director National City Bank, N. Y. City. Director Niles-Bement-Pond Co.

W. B. Mayo, Chief Engineer, Ford Motor Co.

George H. Helvey, The Black & Clawson Co.

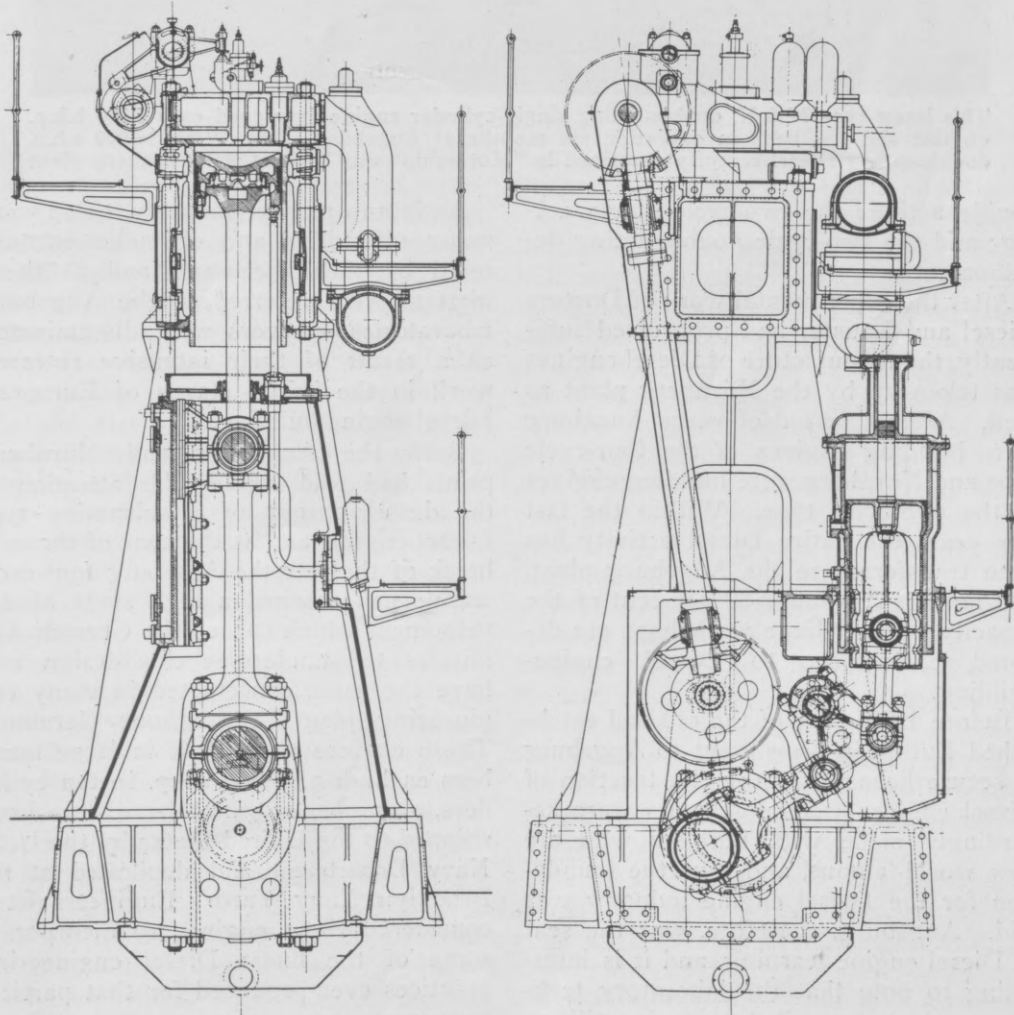
Clarence H. Helvey, The Black & Clawson Co.

John H. Black, Secretary.

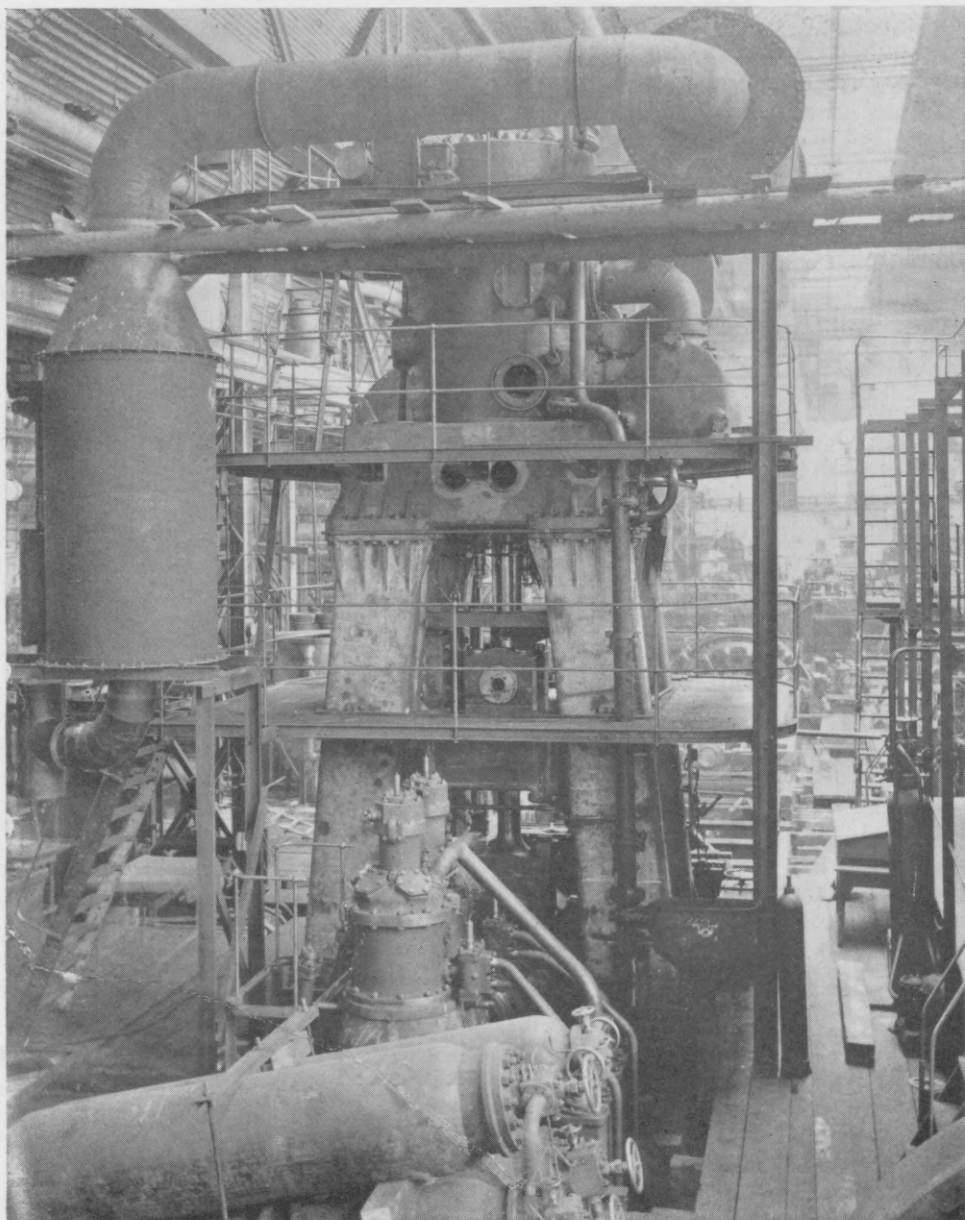
George A. Rentschler, Jr., Managing Director.

Perhaps a few words on the history of the German company with whom they are now associated, will be of interest. The Maschinenfabrik Augsburg-Nürnberg, known as the M. A. N., have two major plants, one at Augsburg and the other at Nürnberg, both employing 7,500 to 8,000 men. For a long period the M. A. N. has been building various kinds of power machinery, railway equipment, etc., for land and sea, and have established an international reputation for fine engineering.

Shortly after Doctor Rudolf Diesel secured his original patents, he went to the Augsburg plant of the M. A. N. Company for the purpose of practical development. There the very first Diesel engine was built, jointly under his supervision and that of Doctor Imanuel Lauster—today the managing director of the Augsburg plant. From this small beginning at Augsburg, a single-cylinder experimental engine, in successive steps has been evolved the Diesel engine as it is known today. These steps have included the four-cycle single acting; the four-cycle



Cross-section and end elevation of four-cycle single-acting M.A.N. engine. Note spur bevel-gear drive for camshaft and compressor drive located in same housing



This latest-type M.A.N. double-acting single-cylinder engine developed over 1,300 b.h.p. on test and has been in operation six months at Augsburg. The 12,000-17,000 s.h.p. double-acting Diesel recently described in "Motorship" was built at the Nurnberg plant

double acting; the two-cycle single acting; and the two-cycle double acting developments.

After the experimental work of Doctors Diesel and Lauster had progressed sufficiently, the manufacture of Diesel engines was taken up by the Nürnberg plant as well. After a period of years Augsburg were building engines of the four-cycle type and Nürnberg were building engines of the two-cycle type. Within the last few years the entire Diesel activity has been transferred to the Augsburg plant, and now at Augsburg 50 per cent of the capacity of their huge workshops are devoted exclusively to Diesel engine-building.

Before 1900 some of the old and established European firms went to Augsburg to secure licenses for the construction of Diesel engines. Arrangements were accordingly made with builders who are now world-famous, and thus the foundation for the Diesel engine industry was laid. Augsburg, therefore, was the seat of Diesel engine learning, and it is interesting to note that the laboratory technique which prevailed then is still so much in evidence at this time.

As in any pioneer industry, there were many difficulties and obstacles encountered by these licensees, and as these matters were referred to the Augsburg laboratories, answers were disseminated as a result of their intensive research work in the initial stages of European Diesel engine-building.

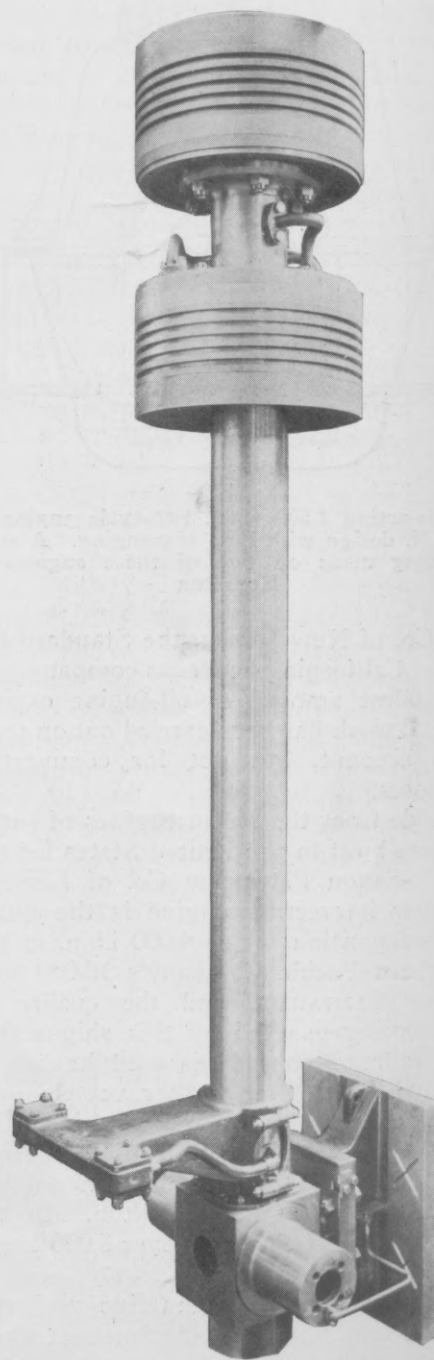
Both the Augsburg and Nürnberg plants had paid considerable attention to the development of a submarine-type Diesel engine, and at the time of the outbreak of the war the Augsburg four-cycle engine had reached a high stage of development which caused the German Admiralty to standardize this design and have the same constructed in many engineering plants throughout Germany. These engines were built in large numbers as high as 3,000 s.h.p. in ten cylinders, a number of which have since been shipped to the United States by the U. S. Navy Department and duplicated at the Brooklyn Navy Yard. Engineers have considered these engines to incorporate some of the finest Diesel engineering practices ever produced for that particular purpose.

One of the many notable achievements

in Diesel evolution was the building, at the invitation of the German Admiralty, of an eight-cylinder, double-acting, two-cycle type Diesel engine of 12,000 s.h.p., which actually developed over 17,000 s.h.p. on tests, and which is the largest Diesel ever laid down and completed. The interesting story of the development of this unit and how it passed very rigid Admiralty requirements shortly before the armistice, was recounted in the pages of *MOTORSHIP* by Dr. Fred. Englert, chief-engineer at Nürnberg.

Since last fall there has been running at Augsburg a new type of two-cycle, double-acting Diesel engine with an output of 1,200 b.h.p. in one cylinder.

This is an experimental engine for producing complete units of very large power, and gives some idea of the intensive research work still carried on in the laboratory and shops at Augsburg. In fact, in their large experimental department one will find cylinders of all systems

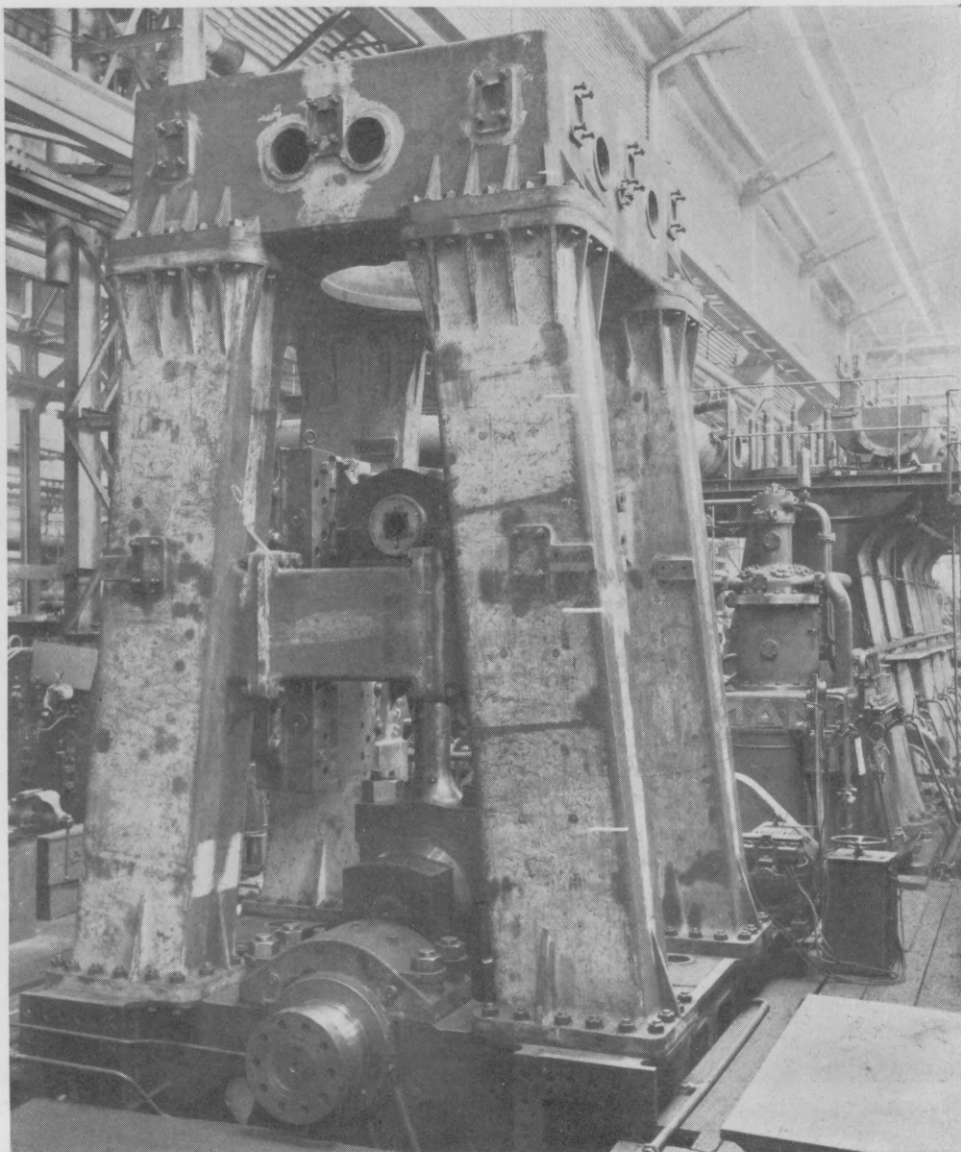


Piston, rod, and crosshead of double-acting engine. The projecting arm carries telescopic cooling water tubes

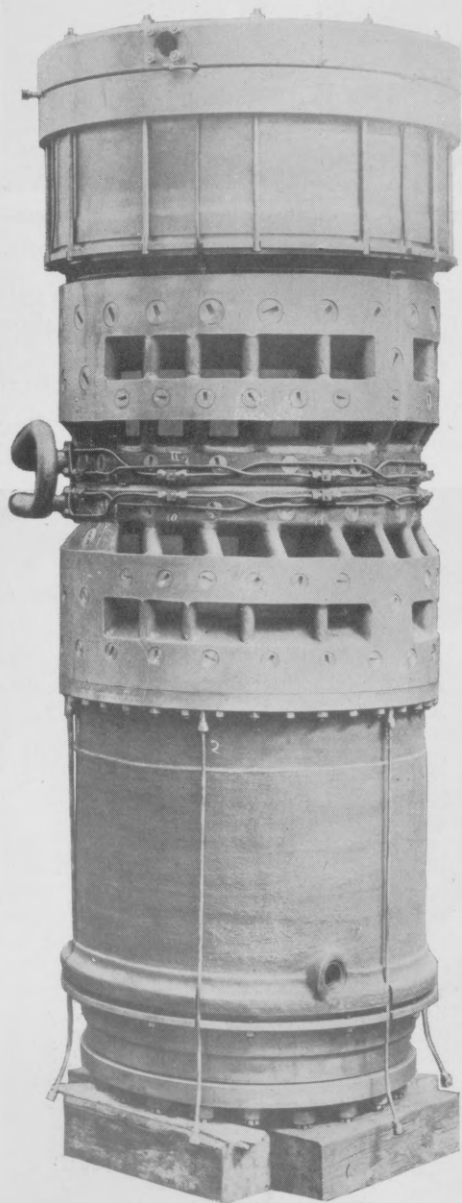
of operation actually running under supervision of expert engineers. There are men at this plant who have spent their entire time since leaving college—almost thirty years—with Diesel progress. The thoroughness and extent to which these men go are rarely, if ever, duplicated in an engineering plant in this country. Upwards of 1,000,000 horsepower in Diesel engines of horizontal and vertical types have actually been turned out from the M. A. N. shops. In addition licenses have been granted to some of the best known shipyards in Germany, such as Blohm & Voss, the Weser Company, Joh. C. Tecklenborg and the Vulcan Maschinenfabrik, aside from licenses in other countries.

We are enabled in this article to give the first descriptions and illustrations of some of the very latest and leading types of Diesel engines now being developed or manufactured at Augsburg and which with minor modifications to suit American conditions will be built by The Hooven, Owens, Rentschler Co.

Among the most notable of these is a two-cycle single-acting engine of 1,500 b.h.p. whose construction is now being taken in hand. Except for the fuel-inject-



Framing of 1,200-b.h.p. double-acting two-cycle single-cylinder engine. Note ease of access to all moving parts



New design of double-acting two-cycle cylinder liner. Well-defined cooling and freedom for expansion of all heated parts are assured

ing and starting devices, this engine is valveless, a fact which makes possible a design of rudimentary simplicity and permits the use of an entirely symmetrical cylinder head. Too much stress cannot be laid upon this feature because symmetry of form makes possible a reduction in the amount of core work, facilitates the production of sound castings, and renders the resulting metal sections immune to heat and stress. As an additional safeguard the cylinder-head casting has been provided with a water baffle directly over the combustion space top, the function of which is to force the cooling water to flow at increased velocity and with intensified heat-absorption over this exposed part.

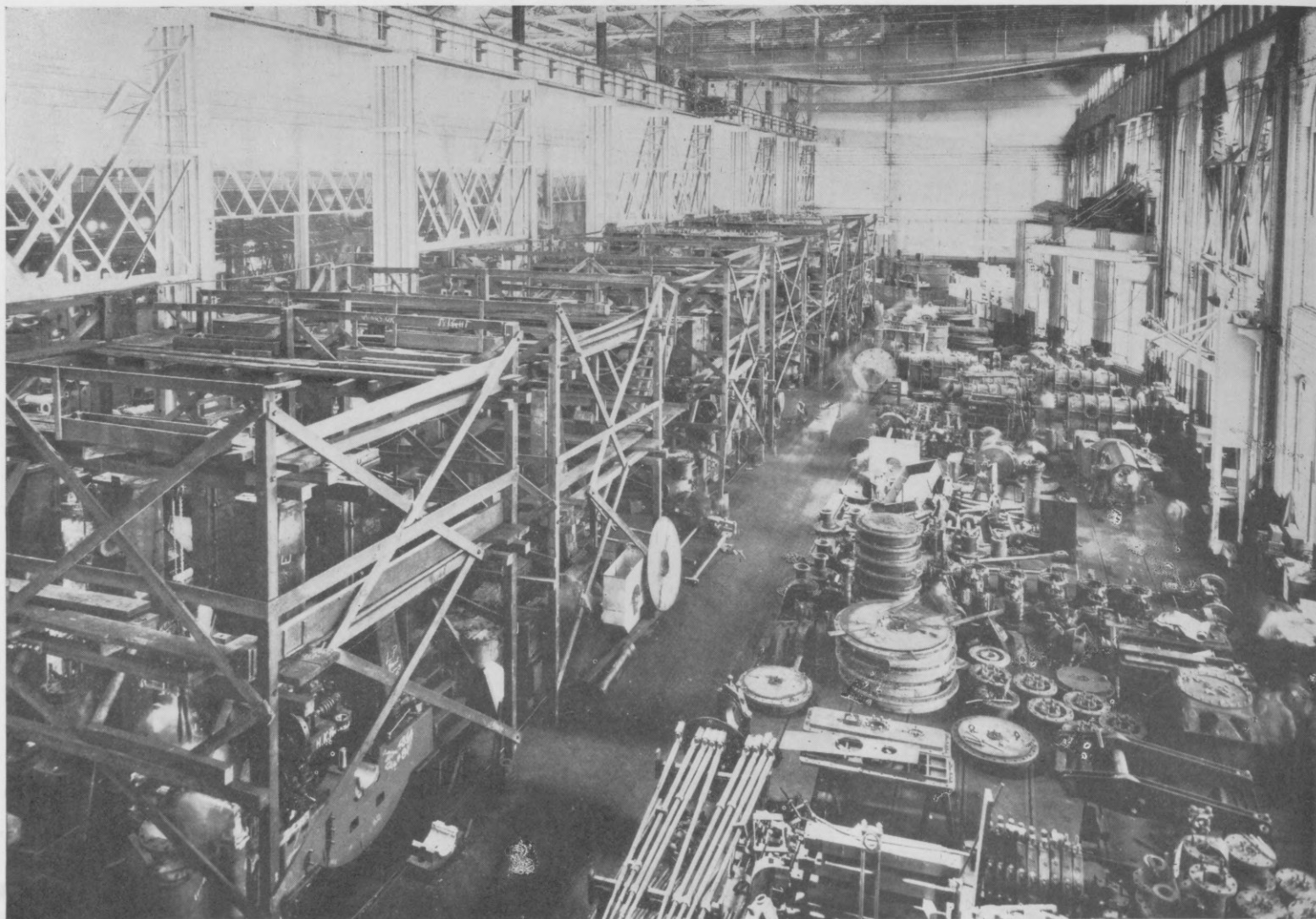
Cooling of the pistons is accomplished by means of telescopic tubing provided with stuffing boxes situated outside of the crank-case, an arrangement which eliminates the possibility of contaminating the force-feed lubrication system with seawater. It is apparent from this that the most modern data on marine operation has been taken into account in the design of the engine.

Principles underlying the frame construction of this machine are also those which more than a decade of marine Diesel engine work have shown to be the most satisfactory. An engine frame is

subject to two kinds of deflections tending to throw the main bearings out of line, one set being due to the machine's own working loads and the other resulting from the deformations of the ship's hull, due to the action of heavy seas. By using A-frames straddling the main bearings, bending of the structure such as is produced by the working loads, is rendered negligible and by joining all the cylinder supports together in such a way as to make one rigid box of the entire engine, hull-deflections are effectively kept clear of it. How this is done in the Hamilton-M. A. N. engine is indicated by the illustrations reproduced herewith.

Steel tie-rods running down from the cylinder heads to the under-side of the bedplate further enhance the rigidity of the engine structure and make possible the direct transmission of the working loads through members whose strength can be accurately controlled both in the design computations and in the manufacturing processes.

By far the most interesting feature of the Hamilton-M. A. N. engine is its exclusive valveless port-scavenging. Both the exhaust and inlet ports are located on the same side of the cylinder, as is clearly shown in the cross-section. Before discussing the scavenging properties of this



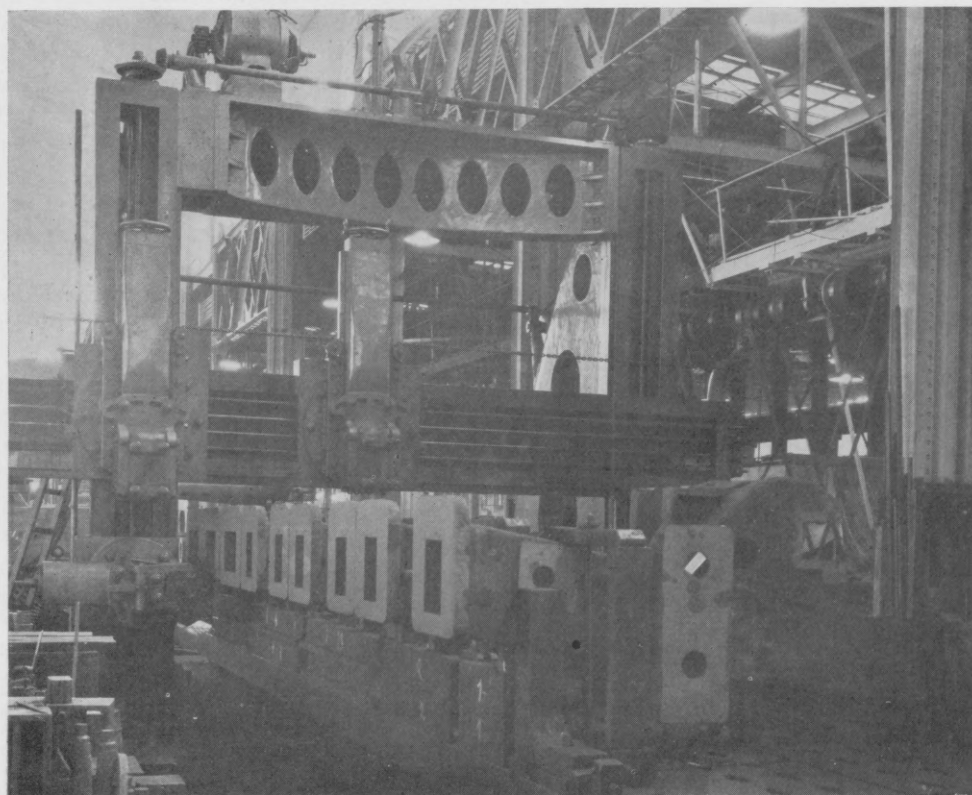
Erecting shop of the H. O. R. plant which is to be the home of the "Hamilton-M.A.N." Diesel engine. Note spaciousness and completeness of handling equipment

construction it may be well to point out that the arrangement minimizes a one-sided heating and consequent distortion of the cylinder liner because the incoming cool scavenging air prevents the bridges

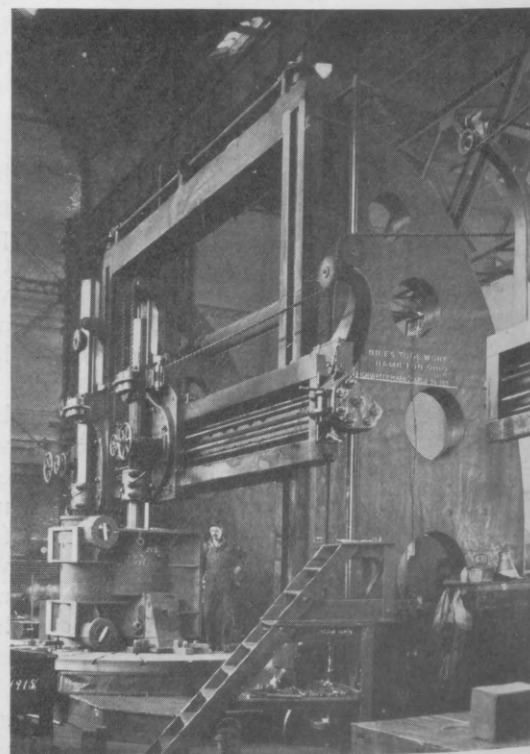
between all the ports from assuming excessive temperatures.

Air entering the cylinder through the lower set of ports from the scavenging header marked "spul-luft" flows over the

top of the piston and traverses the cylinder space in an unbroken circuit, as shown by the arrows. No doubling-back of the air current is required on its way to the exhaust ports with the result that its commixture with the exhaust gases is



Planer adapted to heavy, accurate work, such as is required in machining Diesel engine bed-plates, frames, and entablatures



Diesel engine cylinders and other parts can be accurately machined on this mammoth boring mill

practically eliminated. Low scavenging air pressures may be employed, a fact which further reduces turbulence and the consequent contamination of the fresh charge. If Augsburg was the cradle of "the Rational Heat Motor" (that was Diesel's name for his child), it now appears to be in line for the distinction of being called the home of "the rational scavenging method."

But progress never rests at the M. A. N. works, and they have already applied their simplified two-cycle methods to a double-acting engine which has been developing 1,100 b.h.p. in a single cylinder and was put into operation last fall. It has a bore of $31\frac{1}{2}$ inches, stroke of $41\frac{1}{2}$ inches, and runs at 100 r.p.m. Four columns reinforced by steel tie-rods support an entablature on which is mounted an integral-cast double-acting cylinder.

Readers of MOTORSHIP are familiar with the predecessor of the large engine here referred to. Double-acting construction in both vertical and horizontal designs is nothing new to M. A. N., and their latest development, based as it is on years of pioneering work successfully concluded, doubtless will shortly be made available to American shipowners as the result of efforts on the part of the Hooven, Owens, Rentschler Co. These facts are important to the reader of this article as an aid to a full appreciation of the significance of the engineering facts here set forth.

The cylinder of the double-acting engine, as has been stated, is cast integral as far as the outer water-jacket is concerned and is well suited for accommodating the up-and-down loads resulting from alternate combustion above and below the piston. Since it has no direct contact with heated gases it is subject to mechanical stresses only, which its ample proportions can easily take care of.

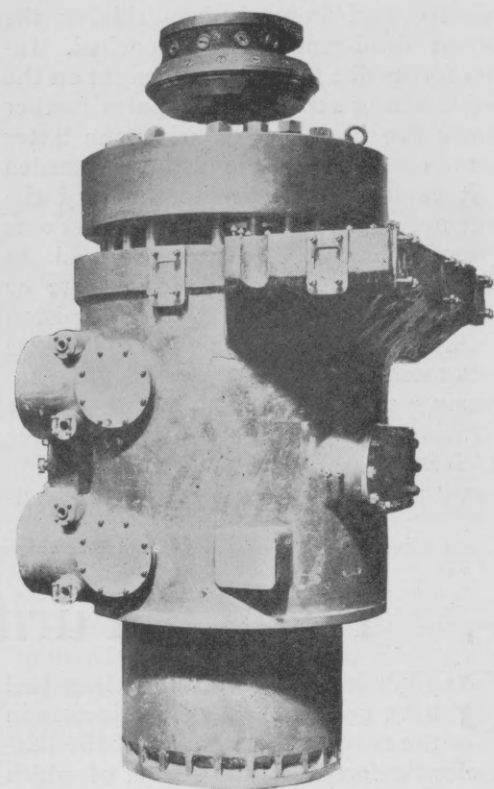
Conversely, also, the cylinder liner has been designed with a view to giving un-

restricted expansion resulting from high temperatures, but is relieved from the major working stresses. Its cooling has been thoroughly studied and all parts of it subject to heat are immersed in actively flowing water. Whereas the importance of these provisions was recognized by M. A. N. engineers years ago, their development work on the historic engine already referred to has made it possible for them to crystallize them into manufacturing practise such as is exhibited by the design under consideration.

Just a glance at the illustration of the double-acting piston and rod is necessary to show that this element is the product of skilled engineers who have had years of contact with this kind of work. Simplicity speaks from every line of it, yet the searching eye will also note that all the requirements of double-acting service have been fully met. Cooling water for the hollow rod and pistons is introduced through telescopic tubes mounted on an arm provided for the purpose, and circulates through flanged tubing visible at the side of the arm and between the head-end and crank-end pistons.

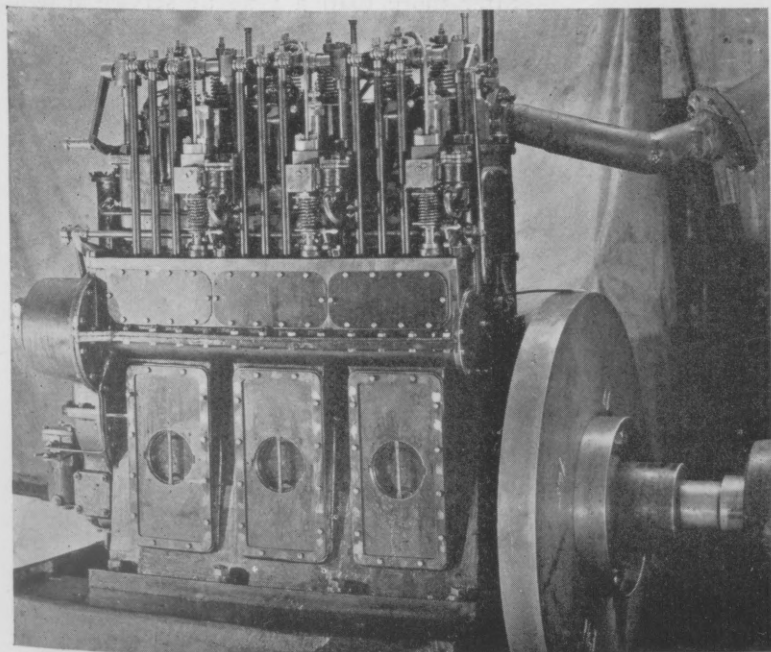
A crosshead slipper of a type long familiar to marine engineers is also shown in the illustration. A double-acting crosshead takes thrust in one direction only while the engine is running in a given direction, a fact which makes the gib type here used well adapted for this service. The large area on the back of the slipper, which is the side that does all the work, is amply proportioned to stand full load conditions for an indefinite period of time. The two astern slides inboard can also be proportioned to give all the surface needed for the longest periods of astern running that are met with in practice.

An interesting point to be noted in connec-

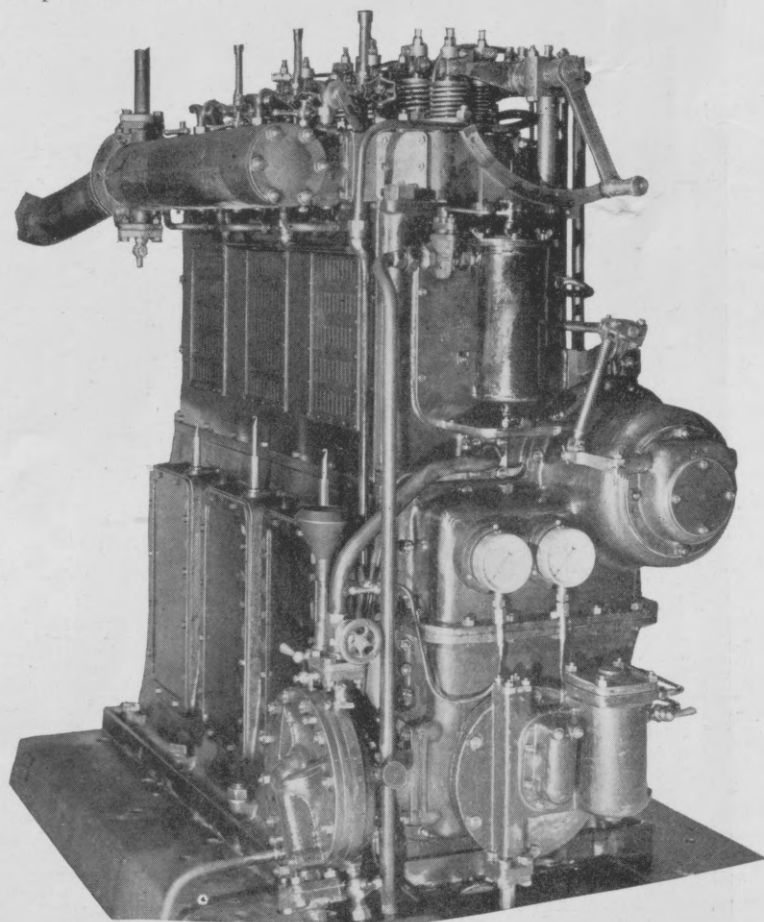


Cylinder-jacket of double-acting two-cycle engine is integral-cast

tion with double-acting bearing pressures in general is that the crosshead pins, crankpins, and journals of this type of machinery are less severely taxed than in a corresponding single-acting engine. During the down-stroke, say, compression in the crank-end of the cylinder builds up long before the stroke is completed and balances more and more of the



Front view of high-speed M.A.N. engine showing fuel injection pumps driven by push rods from the camshaft



Operating end of high-speed airless-injection engine suitable for use as a marine auxiliary. Its complete pumping equipment contained in housing shown makes this an independent unit

pressure load from the top side as the bottom dead-center is approached. Inertia forces due to the extra weight on the double-acting reciprocating parts further relieve the bearings. During the latter part of compression, the piston is retarded as it comes to the dead-center and the force necessary for bringing it to rest acts in opposition to the gas pressure load. In other words, if the crankpin were to be momentarily disconnected, the piston would still tend to keep on going because of its momentum, acting as a ram in compressing the gases.

During expansion, also, the inertia force which is necessary to speed up the piston from its condition of rest at the top dead-

center acts in opposition to the combustion pressure, which is thus prevented from acting on the bearings.

Although inertia forces also help the single acting two-cycle engine, their effect is particularly marked in combination with the top-and-bottom cushioning effect characteristic of the double-acting two-cycle machine. As a consequence of this, the Blohm & Voss-M. A. N. double-acting engines of the motorship FRITZ, described in these pages, gave no trouble at all and although they were oiled by an old-fashioned drip system, the bearings were strikingly free from trouble.

But single-acting engines have won for themselves so strong a position because

of the decades of good service which they have given that no engine building program would be complete which did not include them. Accordingly The Hooven, Owens, Rentschler Company is also taking up the designs of the latest type of four-cycle Diesel engine which is illustrated herewith in cross-section for near future construction. A frame construction resembling that of the two-cycle single-acting engine already discussed is also used here. Tie-rods take the main stresses and A-frames astride the main bearings support the working cylinders. The crosshead slide connects each pair of frames on one side, leaving the other side open for operating purposes.

Fuel Oil Purification on Ferry "Poughkeepsie"

GOOD lubricating oil and clean fuel have been two important factors in the successful operation of the Diesel electric ferry POUGHKEEPSIE, of which we printed a description in our March, 1923, issue.

Lubrication, as everyone knows, is as vital to the operation of any prime mover as fuel itself, and the fact that the POUGHKEEPSIE has been steadily in commission for over a year, shows that her

Success of First Year's Operation Contributed to by Centrifugal Purifiers Guarding Engine's Interior Parts Against Water and Solids Removed From Fuel and Lubricating Oils

lubricating oil and fuel were being properly taken care of.

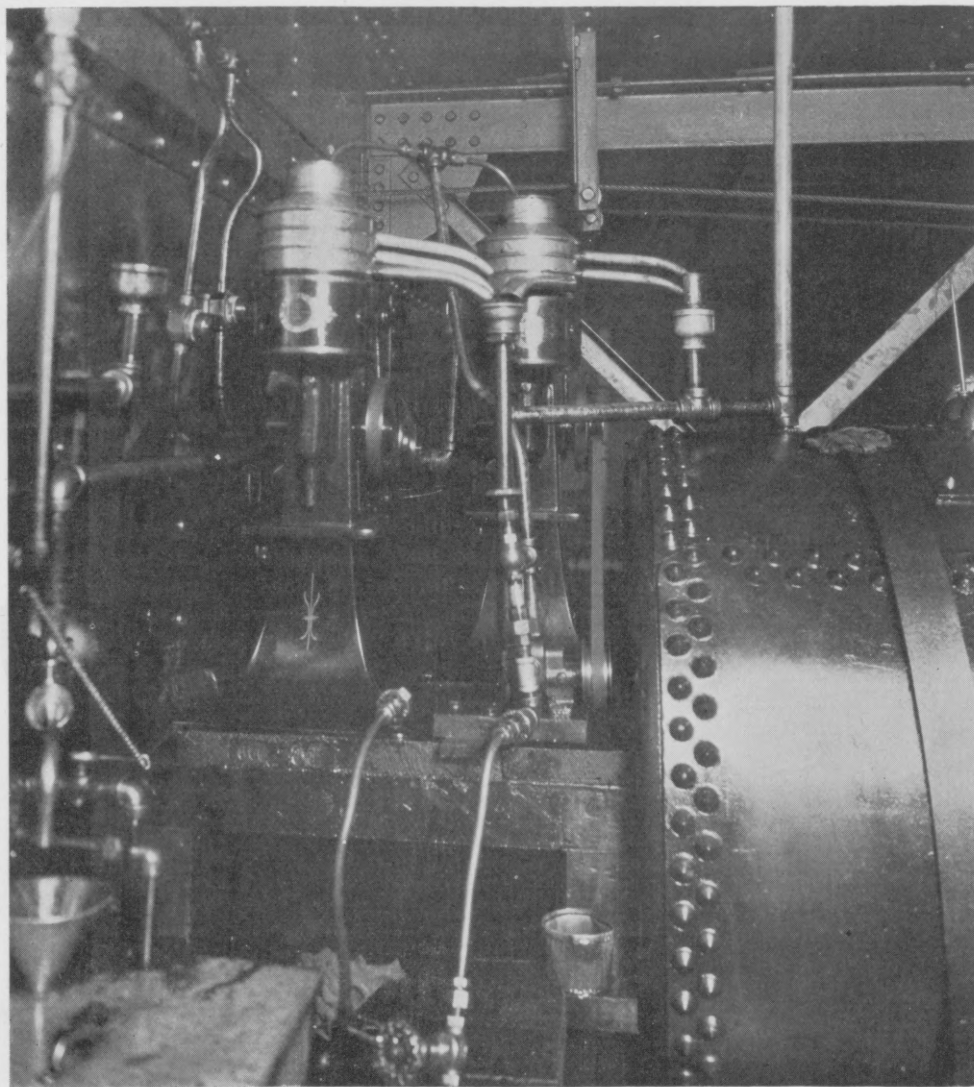
This ferry, it will be remembered, runs

between Poughkeepsie and Highland, on the Hudson River, and does a heavy automobile business during the summer months. Owing to the use of Diesel engines as her propelling power, she is an unusually handy type of craft for this service, since the upper deck is entirely unencumbered by any vertical shafts such as are invariably found on ordinary steam ferries. This, alone, has made her a profitable boat to operate, and her engines are never stopped during sixteen hours out of the day.

She was built in the Mill Basin, Brooklyn, yards of the Atlantic, Gulf & Pacific Company, and has a length over guards of 140 ft., beam over guards of 52 ft., total draft of 10 ft. and a displacement of 400 tons. Falk herring-bone gears, giving a $3\frac{1}{4}$ to 1 inch reduction, and Falk-Bibby flexible couplings were installed between the motors and the propeller-shaft and 60 in. by 60 in., semi-steel Kearfott propellers, to operate at about 220 r.p.m. were fitted.

So silent was the operation of the gears after more than a year of service that it was impossible for us to tell whether they were running or not. While making several trips back and forth on the ferry it was always necessary to ask the engineer whether we were in the slip or in the stream and the absence of noise or vibration thus attested is considered particularly remarkable in view of the fact that the gears are located down in a tubular keel where they cannot receive the same attention as that given to the rest of the machinery. In fact, it is the use of the gears which has made the hollow keel a workable proposition.

The engines are of the Winton-Diesel type, with six $7\frac{1}{2}$ in. by 11 in. cylinders, and operate at 450 r.p.m. The main Westinghouse generators are rated at 90 kilowatts each and supply 250-volt direct current. Two 9-kilowatt Westinghouse generators, driven from the main-engines, furnish excitation for the main-generators and motors, as well as power for lighting



These centrifugal purifiers on the "Poughkeepsie" run all the time that the main engines are running and continuously cleanse both fuel and lubricating oil. The large tank stores the treated fuel

and other purposes when the vessel is in operation. For use when the main-engines are shut down there is a $7\frac{1}{2}$ -kilowatt gasoline-driven generator.

Owing to the considerable period over which this boat has been in operation, reliable averages of her fuel and lubricating oil consumptions are available. As has been stated, the daily operating period is sixteen hours, during about half of which the engines are pulling full load. At no load, of course, the fuel consumption of a Diesel engine decreases to only a small fraction of full power requirements, but the consumption of lubricating oil is not much affected.

It takes 180 gallons of 32° Beaumé fuel oil, costing $5\frac{1}{2}$ cents per gallon and 4 gallons of D.T.E. extra heavy lubricating oil at 65 cents to run the **POUGHKEEPSIE** per day. The total daily cost of these items is, therefore, \$12.50, for which just about one ton of hard coal could have been bought.

Both the lubricating and fuel-oil for this vessel are treated with De Laval centrifugal purifiers, a fact which has assisted to produce the successful results which have been achieved. Lubricating oil in trunk-piston engines is bound to become contaminated with carbon and combustion residues and it was an eye-opener to us to see a wooden box full of chunks of coke-like material which had been scraped from the separator bowls and which otherwise may have caused bearing wear in the engines. But our greatest surprise was to see transparent high-gravity fuel-oil being run through one of the separators and to note the surprising amount of deposit which was being removed from it, and which also would have played a part in the causation of operating troubles had it not been taken out. Although it was impossible for us to analyze this material, we believe it was composed mainly of what might be called "tank-and-handling-dirt" such as no amount of care in refining can keep from fuel-oils used and handled for ships.

So great a diversity exists among the chemical compositions of the fuel-oils available for oil-engines, that until progress has been made with the work of standardization, it will be a good thing to treat them with the means which are available. The centrifugal purifier naturally does not affect the chemical compositions of the oils, nor does it alter its physical characteristics, but the evidence which we have been able to gather thus far would indicate that when an oil is harmful it exerts its bad influence by virtue of properties other than chemical.

Unsuitable oils are often found to produce bad results not because of large percentages of material considered chemically unsuitable, but because of the fact that they are almost invariably associated with the physical property of high viscosity. It is well known, for instance, that sulphur burns in an engine to sul-



Winton Diesel-electric ferry on the Hudson has made good operating record since she was put in commission over a year ago

phurous anhydride, a gas which in itself is incapable of attacking or otherwise injuriously affecting the metal of the engines at temperatures encountered in the Diesel cycle. It is only after the engine is shut down that the gas forms sulphurous acid with the water condensed in the engine.

We hope to be able to throw more light on the question of how much damage is done by sulphur content. Asphalt, too, being composed of hydrocarbons, should pass out as carbon dioxide and water.

It would appear that the harmful effects ascribed to sulphur and other chemicals is in reality due to the fact that high viscosity is almost always associated with high sulphur and asphaltum content. Now viscosity might not necessarily be harmful as far as its action in the engines is concerned, but there seems to be little doubt that this property of an oil makes it pick up every conceivable kind of solid and liquid impurity with which it comes in contact. Salt water when entrained in a high viscosity oil is very difficult to remove and solid impurities such as tank scale and sandy material cannot be readily separated in ordinary heating tanks.

These things are not chemical properties of the oil itself and standardization of fuel oils must take account of this fact. No amount of care on the selection of fuels will remove salt water and solids from ships' double-bottoms, but a centrifugal purifier will. It was a surprise to use to find the amount of residue which was being continuously removed by the purifier on the **POUGHKEEPSIE** from a light transparent fuel oil having a gravity of 32° Beaumé. She is the first ship in American waters which to our knowledge, is using nothing but centrifugally purified fuel oil for its main engines and the operating results briefly indicated at the beginning of this article fully justify the wisdom of this procedure.

Five New Roosevelt Motorships

While our shipyards and engine plants must regret that the five motorships for the

Roosevelt Steamship Line were not built in the United States and thus form a fitting memorial to one of the greatest Americans that ever lived, the horse-sense of its directors in adopting Diesel power could well be followed by others. A similar policy would enable more American ships to keep on the seas. The Roosevelt vessels on their round-world voyages will effect economies in fuel alone of about \$25,000 per ship per trip, aside from numerous other savings and increased earning capacities. They have been named **SILVERELM** (already en route to New York), **SILVERCEDAR**, **SILVEROAK**, **SILVERLARCH** and **SILVERPINE**. Two have 2,800 i.h.p. Neptune Diesels and the other three have single-screw Doxford opposed-piston oil engines. Previously we have only referred to four motorships, the fifth not having been mentioned by the owners.

The Roosevelt Line is planning additional motorships, but if commercially practical will construct them in American yards, and operate them under the American flag. A fifty per cent lower price caused the orders for the first five freighters to be placed in Great Britain. The line also may purchase steamers from the Shipping Board and convert them to Diesel power if the Edmonds Bill is approved by Congress in a practical form.

The new motorship fleet will run in a world service in conjunction with two motorships now constructing in Japan for the Kawasaki Company that are to have British-built Brown-Fullagar Diesel engines. (See page 356, May, 1924). The Kerr Line interests, with which the Roosevelt Line is connected, for years have been closely associated with Wilhelm Wilhelmsen the Norwegian shipping magnate who now owns the largest fleet of cargo motorships under one house-flag. So the position of the Roosevelt Line in the world's freight movement should be particularly strong.

The British marine press has repeatedly referred to these motorships as being owned by Stanley & John Thompson, Ltd., the Silvercedar Shipping Co. and the Mount Line respectively, of London, which may give the impression that they are English owned.

Motorship

Trade Mark, Registered

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Published Monthly in the Interests of Commercial and Naval Motor Vessels and for Recording International Progress of the Marine Heavy-oil Internal-Combustion Engine

Publication Office, 305 Washington Street, Brooklyn, N. Y.

Editorial, Advertising and Subscription Office,

27 PEARL STREET, NEW YORK, N. Y.

(Cable Address—Motorship, New York)

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Subscriptions rates: U.S.A. and Mexico, \$3.00 per year; Canada and foreign countries in the postal union, \$3.50. Single copies: United States, 25c.; Great Britain, 1/6. Other countries, 35c.

"Motorship" is published on the 20th of the month prior to date of issue, and all changes in, and any new copy for, advertising must be in the hands of the publisher prior to the 5th of each month. Notice of discontinuance of advertising must be given before the 1st of the month, preceding issuance.

Current Motorship Activity

EVERY three months Lloyd's Register publishes the position of ship construction throughout the world and these figures are always well worth analyzing. Everybody knows that ship construction today is at a very low ebb, there being less than 2,500,000 gross tons of merchant vessels now building in all parts of the world. But, with the steady decline of steam-driven vessels the curve of motorship building is rapidly rising. On March 31st, 1924, there were no fewer than 154 oil-engined vessels aggregating 694,712 gross tons (1,111,000 d.w. approx.) on the ways of which tonnage a little under 50 per cent was under construction in Great Britain and Ireland. The British, while constructing nearly half the world's motorship tonnage, are still turning out a large number of steamers due probably to the powerful influence of her coal interests. There are also building 325 British steamers of 1,140,268 gross tons.

The proportion of motorships to steamers building is higher in the rest of the world, including the United States, than in the British Isles, being 369,552 gross tons, compared with steamers aggregating 661,448 gross tons. Outside of the British Isles more than 50 per cent of the merchant tonnage now in the shipyards is Diesel-driven. How greatly in favor today is Diesel drive among shipowners can best be understood when we recall that in the phase of the shipbuilding boom immediately following the war motorships only formed two-and-a-half per cent of the total ocean-going mercantile tonnage.

Lloyd's Shipbuilding Returns, March 31, 1924.

Building in Great Britain

Steamers	Tonnage	Motorships	Tonnage
325	1,140,268 gr. tons	55	325,190 gr. tons

Merchant Ship Construction in Other Countries Including the United States.

Steamers	Tonnage	Motorships	Tonnage
263	661,448 gr. tons	99	369,522 gr. tons.

Less than one-third of the merchant vessels building in Great Britain are Diesel-driven. In other countries including the United States, over 50 per cent of the ships being constructed have Diesel engines. This makes the foreign market of vast importance to British ship and engine builders and equipment manufacturers. Careful analysis of the world's motorship construction will show that a large proportion of the tonnage building in Europe is actually for American ownership.

Motorships Under Construction March 31st, 1924.

Countries.	No.	Steel Gross Tonnage	No.	Wood Gross Tonnage
Gt. Brit. and Ireland	53	324,570	2	620
United States:—				
Atlantic Coast	14	18,630	..	...
Gulf Coast	..	..	..	..

Countries.	No.	Steel Gross Tonnage	No.	Wood Gross Tonnage
Pacific Coast	..	..	..	..
Great Lakes	2	16,400	..	..
British Dominions:—				
Australia	..	..	..	..
Canada	..	..	..	..
Hong-Kong	1	110	..	..
Others	..	..	..	..
Belgium	..	..	..	..
Brazil	..	..	..	..
China	..	..	..	..
Danzig	..	..	..	..
Denmark	11	36,267	..	..
Estonia	..	..	1	150
France	2	21,500	..	..
Germany	26	151,547	..	..
Holland	10	38,275	..	..
Italy	3	22,700	9	3,993
Japan	5	14,540	..	..
Jugo-Slavia	..	..	2	340
Norway	3	4,625	..	..
Portugal	..	..	..	..
Spain	..	..	..	..
Sweden	9	40,270	1	175
Total	139	689,433	15	5,278

Grand Total (Steel and Wood) 154 motorship of 694,712 gross tons (1,112,000 tons deadweight). Lloyds seem to have omitted the 6,000 h.p. twin-screw passenger-cargo motorship building for the Brazilian National Navigation Co. in their own shipyards at Rio de Janeiro. Also conversions of steamers to Diesel power, of course, are not included.

Transportation on Our Great Rivers

GROWING interest in oil-engine propulsion is now to be found among owners of those picturesque but decidedly uneconomical steam-driven stern wheelers on our great rivers of the middle west. The position has been reached where a determined drive by oil-engine builders, supporting the work of this magazine, will result in an active market, especially as large savings can be realized by the buyers. Less than half a pound of fuel-oil compared with eight pounds of coal per horsepower hour offers ample opportunities to bright oil-engine salesmen. A recent trip in the neighborhood of the Ohio, Tennessee, Warrior and Mississippi rivers revealed the information that quite a number of stationary-type horizontal and vertical oil engines have been installed in stern-wheel craft additional to those lately pictured in our pages.

Income Tax Cuts From Conversion Cost

AMONG the numerous items of saving which result from the conversion of ships to oil-engine propulsion is one which has not had the attention that it deserves. In casting up trial balances of expenditures and savings to be realized from the proposed conversion, say, of a steam propelling plant into one of the heavy-oil internal combustion type, the value of the old machinery which it had at the time of scrapping may properly be deducted from the income tax returns of the year in which the change is made.

According to the best income-tax consulting service available, almost any kind of a scrapped plant may be given a proper valuation as of the date of scrapping and will be considered as an item properly deductible from the gross income returns of the year. In general, the amount to be subtracted from the return would be calculated by deducting from the value of the old plant its depreciation rate times the number of years it has been in service.

Taxes saved as the result of such a deduction constitute a direct discount off the price of an oil engine installation and cannot be neglected in making an accurate estimate of the cost of converting a steam or a gasoline vessel into one of the modern heavy oil engine type. Anything that reduces the first cost of such work naturally makes financing easier and effects continuous savings in interest charges.

Fifteen per cent is a figure stated as representing the extra first cost of an oil engine plant in comparison with steam propelling machinery, but this would appear to be subject to a material decrease in those cases where the scrapping of old equipment is involved. Because of the insufficient attention which has hitherto been paid to this subject, no figures of a case which might serve as an example are at hand, but an early publication of such data as it becomes available is expected.

One large firm with which we have been in touch stated to us that they have a regular policy of providing for a depreciation reserve which takes care of the charging off of investment which has proved obsolete, and also takes care of the reduction in the value of losses in assets through wear and tear.

But it is just the automatic nature of these tax-return accountings that makes them apt to be left out of account at times when preoccupation with engineering matters incident to a conversion is likely to prevent financial niceties from getting their due share of consideration. In the majority of cases, to be sure, the bookkeeping and financial routine of an efficient company would ultimately insure that the tax-saving made possible by the oil-engine conversion would be realized. Emphasis is necessary at the other end of the process and the proponents of conversions would do well to stress in advance all the savings

that can be made by the substitution of oil engine power for obsolescent propelling machinery.

There is no class of vessels available for conversion for which the tax-economy of oil-engine substitution cannot be urged. Most interest is, of course, centered in the vessels which are the subject of the conversion bill now pending before the United States Senate and in the case of privately-owned ships for whose reconditioning the bill will make loans available, many thousands of dollars could be saved on income taxes by deductions based on the boilers and steam engines to be discarded. But no allowances can be made for the scrapped machinery of steamers bought from the Board at the specially low conversion price.

Work-boat and fishing-boat undertakings come in for their share of benefits from income tax reductions as well as steamers, and although the gross amounts involved are not nearly as large, they bear the same important relation to the budget of the small towing company or fisherman. Gasoline engines are yielding more and more to the advantages now being gained by the heavy-oil engine and everyone concerned in this work should see to it that the owners of gasoline-driven craft are thoroughly advised as to income tax savings which the substitution of oil engine power would make available to them.

Development of the American Submarine

Publication of Most Interesting Book Written by Captain Frank T. Cable

RARE is the person who has not at some time in his life felt the urge to invent, to create and build, to set up in his mind the structure of some new thing which has not had existence before. There are many who are not conscious of a wish like this, but there can be little doubt that it is one of the ingredients that make for charm and fascination in successful fiction.

But a book need not necessarily be fiction to possess this property, as is illustrated by Frank T. Cable's story on "The Birth and Development of the American Submarine," published by Harper & Brothers and obtainable through MOTORSHIP. The interest of anyone reading it is intensely held by the account of how the ideas for a submarine boat took shape in the mind of the inventor, John P. Holland, and the elements of conflict and conquest are brought out as vividly as in any romance. At the same time the

material presented is of a thoroughly historical character since it was gathered and recorded by the author in the course of thirty years of submarine development which he experienced in close association with the inventor.

On the other hand, the book is not in any sense technical and says what it has to say in an easily-flowing yet dignified and accurate style. It is well illustrated from photographs and cross-sectional drawings which supplement the text in such a way that anyone interested in the engineering aspects of the pioneer submarine work can find all the essential details relating to it.

An aspect of the submarine question which naturally overshadows the story of this modern engine of war is the part which it plays and has played in international relations, a matter which Captain Cable takes up in detail and to which he contributes a

good deal of material which would otherwise not have received the consideration to which its importance entitles it.

The cordial personal relations that always existed between Captain Cable and the inventor Holland permeate the pages of the book and impart to it a warm feeling reminiscent of the handshake of a friend.

England to Denmark by Motorship

A fifteen-knot passenger-cargo motorship has been ordered for the Eiseberg-Harwich service by the United Steamship Company of Copenhagen. Particulars of this vessel are as follows: Twin-screw, trunk-piston Burmeister & Wain Diesel engines developing a maximum of 2,100 i.h.p. each, will produce their rated power at 200 r.p.m. with the aid of a supercharger or at 175 r.p.m. without supercharges. These are six-cylinder machines with stroke and bore dimensions 21.65 in. by 35.43 in.

Motor-Steamer Dolius Runs Trials

Unquestionably the most unique merchant vessel in service is the motor-steamer DOLIUS, owned by Alfred Holt & Co., Liverpool, which has just concluded a series of trials. This vessel and her machinery have previously been described in MOTORSHIP, her propelling plant consisting of combination oil-and-steam engines, the steam being supplied from a regenerator that is oil-fired and augmented by exhaust heat from the oil-engine part of the machinery. The regenerator is fed with the heated cooling-water from the cylinder jackets. The DOLIUS is of 11,370 tons loaded displacement, but her draft when on trials was not given. On the speed runs an average of 12.17 knots was attained and handled well at slow speeds. Below about 20 r.p.m. only steam is used.



Launch of the "City of San Francisco," first of the two motorships for the Pacific Mail Steamship Co. of New York at the Götaverken, Göteborg, Sweden



Double-ended ferry has twin oil-engines selectively driving two propellers at each end. Remote control to maneuvering station in pilot house enables one man to handle boat with safety and precision

Twin Double-End Drive on Oil-Engined Ferry

AS the use of automobiles is spreading over the land with wild-fire rapidity, means must be provided for regularly transporting them across the multitudes of streams and rivers that traverse the country-side. To judge by the material which is accumulating in our files and on the basis of which we are planning to publish a comprehensive article, an adequate number of highway bridges to meet the urgent needs of the rapidly expanding automobile traffic does not come within the realm of immediate possibility on account of the prohibitive cost involved.

Ferries give the most immediate prospect of relieving automobile traffic of congestion and detours. Compared with interest and maintenance charges incurred in the construction of highway bridges and the necessary engineering works, the total costs of equivalent ferry operation are generally quite insignificant. It is, therefore, not surprising that this type of vessel is being built in rapidly increasing numbers and may be said to have entered a new stage of development.

Ferry-boat construction is therefore being considered from a new angle and the more modern methods of equipping and propelling them are coming in for their share of attention. Any wide-spread use of steam propulsion would represent a retrogression in contrast to the forward-looking development which is going on and it is therefore only natural that oil-engine power bids fair to overshadow steam installations in the increased constructions which are now being seriously taken in hand.

The CHESTER H. BRYAN Is a Big Help to Automobile Traffic Across the San Jacinto River; Selective Drive From Twin Oil Engines to Four Propellers Is Under One-Man Control

Just one illustration of what is going on is afforded by a double-ended ferry which is being commissioned for transporting automobiles across the San Jacinto river near Lynchburg, Texas. It is named the CHESTER H. BRYAN and is being operated by the officials of Harris County. This is a small community for which the construction of a highway bridge would have been a financial burden, but which can advantageously meet its obligation as regards highway facilities by using the oil engined ferry-boat.

The CHESTER H. BRYAN is 64 ft. long by 32 ft. beam and draws 4 ft. 9 in. of water. Power is furnished by two 46-b.h.p. Wolverine oil engines which drive a pair of propellers (four in all) at each end of this double-ended boat through the medium of friction clutches.

Essential details of this type of engine have already been published in MOTORSHIP over a year ago, and recently in our associated journal, *Oil Engine Power*. Airless injection is used, the fuel being sprayed into the cylinder by means of individual cam-actuated pumps.

The bedplate of the engine consists of a deep trough section heavily ribbed with transverse girders supporting the main bearings. It supports a box frame of rigid but

accessible design and is securely connected to the latter by means of four tie rods astride of each crank-pit. Since each of these rods extends up through deep lugs cast integral with the cylinders and jackets, stress transmission may be said to be accomplished by very direct means.

Cylinders cast in one piece with the water jackets have been adopted as this avoids liners and a resultant complicated joint with the cylinder heads, eliminating the danger of water-leakage into the crankcase. Simplification of the detachable cylinder heads has been carried to a point where this oil engine has scarcely more parts than an equivalent kerosene or gasoline engine. Since the exhaust and inlet valves are seated directly on the casting, the seats get the benefit of good cooling and the complication of inserted valve-cages is done away with. In view of the ease with which it is possible to raise a cylinder head and thus to get at both valves, nearly all the accessibility of the inserted-cage type is preserved. In fact it is questionable whether the mechanical "ginger-bread" that would result from the use of cages on so small an engine would not, in the end, more than cancel their advantages.

A crankshaft consisting of a solid open-hearth forging made of special formula high-grade steel is used. Rarely has a shaft of such large proportions been brought to our attention during all the years in which we have been concerned with oil engines. Pins and journals have a diameter of $4\frac{3}{4}$ " and as the bore is $8\frac{1}{4}$ ", this gives a ratio of pin to bore diameter equal to 0.575, a figure

characteristic of regular Diesel practice. Assuming a firing pressure of 400 lbs. per sq. in. acting through the $8\frac{1}{4}$ " piston on a crank-pin bearing $4\frac{3}{4}$ " long, we get a bearing pressure per square inch of projected bearing area equal to 950 lbs., a figure quite regularly exceeded without any serious consequences whatever in Diesel engines having many times as much power per cylinder as the engine under consideration. As for the main bearings, their bearing pressures are so low that they could suffer an interruption of the lubricating supply for an appreciable length of time before they would be damaged. The total length of main bearings available for taking up the piston load is $15\frac{1}{4}$ ", which results in the surprisingly low figure of 286 lbs. per sq. in. bearing pressure. Fracturing a shaft so proportioned appears next to impossible even if faulty operation should result in higher than normal combustion pressures; and hot bearings appear to have been equally well guarded against.

Whereas the upper halves of the bearing shells are of close-grained cast iron, the lower ones are of high-grade bronze, all lined with a good quality of anti-friction metal. After removing the upper halves, the lower ones can be rolled out without disturbing the crank-shaft or box frame; but as all the bearings are supplied from a McCord force-feed lubricator the necessity for doing this is reduced to a minimum.

Much experience in the design and manufacture of camshafts has recently been made available by the wide-spread adoption of gasoline engines for land and marine automotive purposes. Hence there should be no reasons why the construction practice thus established should not be widely adopted for the valve gear of small and medium powered oil-engines. Cams for the Wolverine engine are turned out on automatic machine from master cams. They are hardened, run in an oil bath formed by a trough cast inside of the crank-case, and are so proportioned as to be practically indestructible.

Fuel supply and injection is accomplished by means of a pump driven by a cam on the

same camshaft which actuates the rollers for the valve push-rods. The cam-roller which transmits motion to the pump plunger is housed and guided in the lower end of the bronze pump-body mounted on the frame. The latter is a wide-open construction permitting ready access to the moving parts of the pump. Regulation is attained as follows: the upward (pumping) movement of the plunger actuates one end of a lever, in the middle of which is a tappet for opening the suction valve. Its other end can be moved up and down by the hand or governor control. After a part of the stroke has been traversed, the tappet on the lever opens the suction-valve of the pump and from then on whatever oil may still be moved by the plunger will simply return to the suction chambers instead of being fed to the spray valve. It is obvious also that the height of the extreme or fulcrum end of the lever will determine the point of time at which the central tappet will make contact with the end of the suction valve. The lower the fulcrum of the lever the more the pump will deliver before by-passing begins and the more will be the power developed by the cylinder. Since the commencement of pumping is always the same, depending upon the setting of the pump cam, proper advance of injection and ignition is at all times maintained, no matter what the quantity delivered or the load on the engine may be.

The characteristics of the Wolverine engine as thus outlined render it well suited to the four-propeller drive which is employed on the CHESTER H. BRYAN. There is a pair of friction clutches to each engine coupled together in such a way that the engagement of only the ahead or the astern propeller is possible at one time or that both of them are out of mesh in the central position of the clutch linkage.

By a simple arrangement of rods and levers the controls for both pairs of clutches are extended up to the elevated pilot house prominent in the illustration. As a result a single operator stationed there is enabled accurately to control the action of the four propellers and to maneuver the ferry-boat

single-handed. In view of the fact that boats of this kind almost invariably run in rapidly-flowing streams and must be piloted in and out of slips in opposition to considerable currents, the importance of handling flexibility such as is assured by the remote-control feature is readily apparent.

Savings in operating personnel effected by it also stand out prominently and carry with them suggestions for similarly equipping other kinds of medium-sized oil engined craft. This is a matter which will command increasing attention from the owners and operators of such boats and will still further enlarge the sphere of usefulness of the oil engine.

Cornell Steamboat Co. Buys Jumbo

AS the result of extensive try-outs which they subjected the direct-drive Diesel tugboat JUMBO, the Cornell Steamboat Company has purchased this efficient craft from the New London Ship and Engine Co., who had chartered her to the Transmarine Lines. She had been used by this firm for steamship and lighterage operations around Newark Bay and New York harbor.

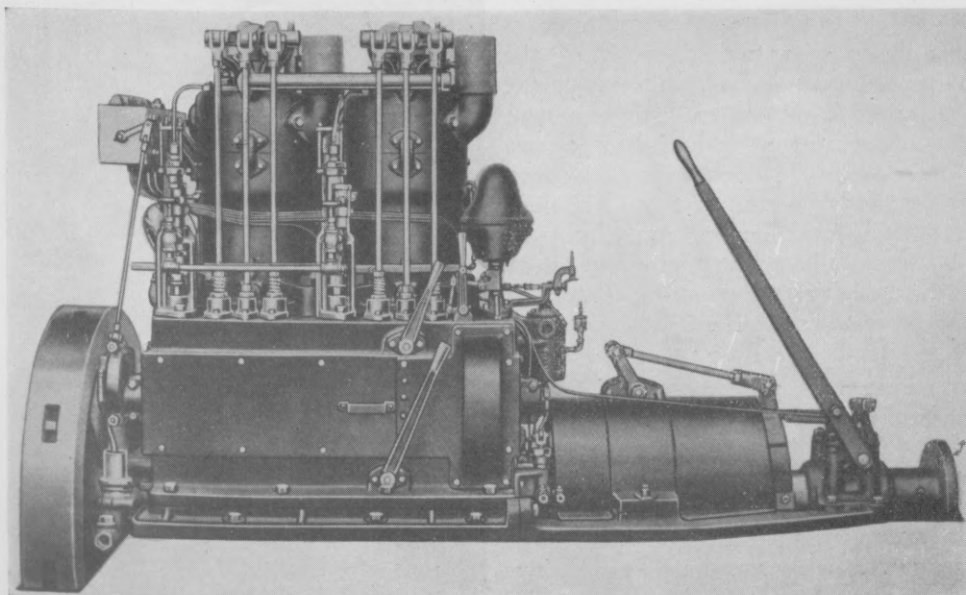
After exhaustive tests of the JUMBO the engineers of the Cornell Co. found her equal in towing power to a steam tug of 800 indicated horsepower. One of the severest tests ever given by them to any tug was the transferring of 70 barges from New York to Albany, 60 of them being fully loaded and amounting approximately to 16,000 deadweight tons. For 78 hours the JUMBO's engine ran at full power varying but one revolution, a performance which it would be difficult to duplicate with most steam vessels. Owing to the fact that she carries only a fraction of the weight of fuel required by an equivalent steam tug for the same radius of action, the JUMBO can complete the New York to Waterford run on an 11-ft. draft, this being another instance of the many ways in which she is superior to steam craft. During the summer the JUMBO will run up and down the Hudson river and in winter will be used in New York harbor both for short and long-distance tows.

While some new vessels are in prospect, definite plans regarding additional motorship tonnage have not yet been made by the United Fruit Co., of Boston.

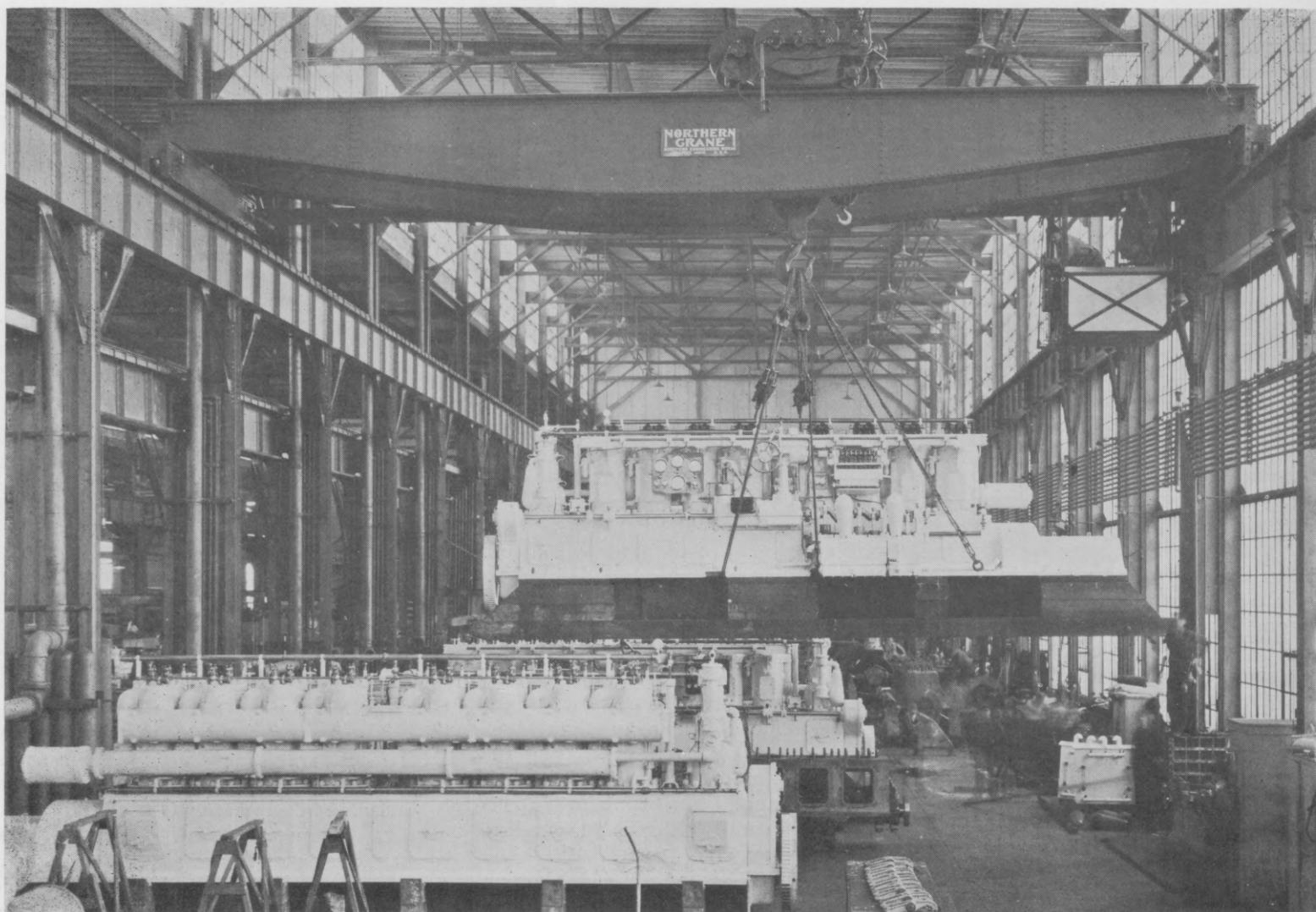
WIERINGEN, is the new name given to the steamer TURBINIA, now being converted at the De Schelde yard to the order of the Rotterdam Lloyd.

Doxfords have launched the 8,000 tons motorship ORASTANO built to the order of Furness Withy. A three-cylinder Doxford opposed-piston oil-engine of 1,850 s.h.p. is installed.

VOGTLAND, a 10,000 tons passenger cargo motorship, was launched May 3rd by Blohm & Voss to the order of the Hamburg America Line. Twin 2,000 s.h.p. Diesels are installed.



46-h.p. oil-engine of this type is fitted with clutches at both ends for driving double-ended ferry at Lynchburg, Texas



Winton Engine Works. Engines are supported on heavy skids and carefully handled in the shipping department

One of America's Prominent Diesel Plants

SUCCESS in the design and manufacture of Diesel-type oil engines has been built up not only on specific Diesel engine experience, but on the practise developed in parent and allied industries as well. It is doubtful whether, if Dr. Diesel and his associates had not found the four-

Quantity Production, Handling and Routing Have Been Highly Developed at Cleveland Plant of Winton Engine Works

cycle Otto engine waiting for them to draw upon for the elements which they needed, the Diesel engine would have reached the state of perfection which it has attained to-day.

An even more remote ancestor of the Diesel-type oil engine is, of course, the steam engine, in whose early development the groundwork for all reciprocating engines was laid. Except, however, in slow-speed crosshead machines, its more obvious characteristics have been all but eliminated and whatever influence it may have had on the modern, high-speed, trunk-piston type of internal combustion oil engine has faded into history.

More immediate predecessors of the oil engine have of course had a much more pronounced effect and among them the automobile engine is pre-eminent. The amazing development which the automotive prime mover has undergone during the past three decades makes it reasonable that a highly-refined technique should have been developed in its manufacture. It may be re-

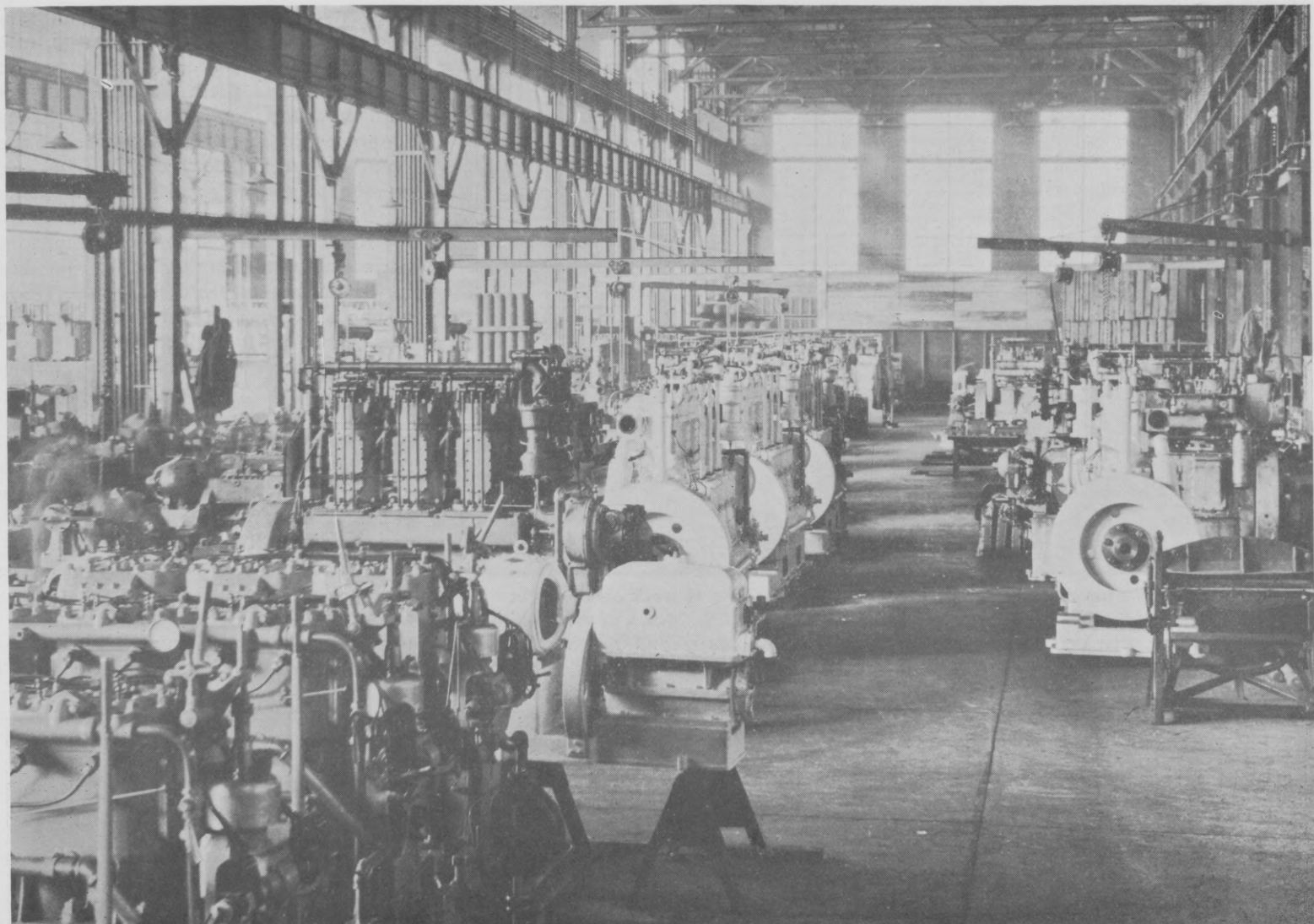
called that in a Gordon-Bennett automobile race of the year 1896, only one contestant was there at the finish and the highest speed attained was 5½ miles per hour. Such facts as these emphasize more than anything else could what has been accomplished in the intervening time.



Alexander Winton, President



George W. Codrington, General Manager



Assembly floor at the Winton Engine Works. Good handling facilities and systematic procedure are among the factors that make this type of engine what it is

It is only natural that the storehouse of mechanical knowledge which has been accumulated in the automotive industries should sooner or later have been opened up to oil engine construction. Selection must admittedly be exercised in reaching into the automobile tool-kit for oil engine implements and there is probably a certain residuum of automotive experience which has no application to the heavy-oil machine. Nevertheless, it would be difficult to find an industry which is so highly developed and at the same time so closely allied to the manufacture of oil engines.

As an old-established builder of high-grade automobiles and their engines, Alexander Winton needs no introduction. For the reasons outlined his firm was well-fitted to establish the Winton Engine Works in 1912, which is now devoted to the manufacture of Diesel-type oil engines. They are, therefore, among the American pioneers in this field and can draw not only on their automobile engine manufacture for the right kind of oil engine practise, but have accumulated a valuable stock of information on heavy-oil machines of the Diesel type as well.

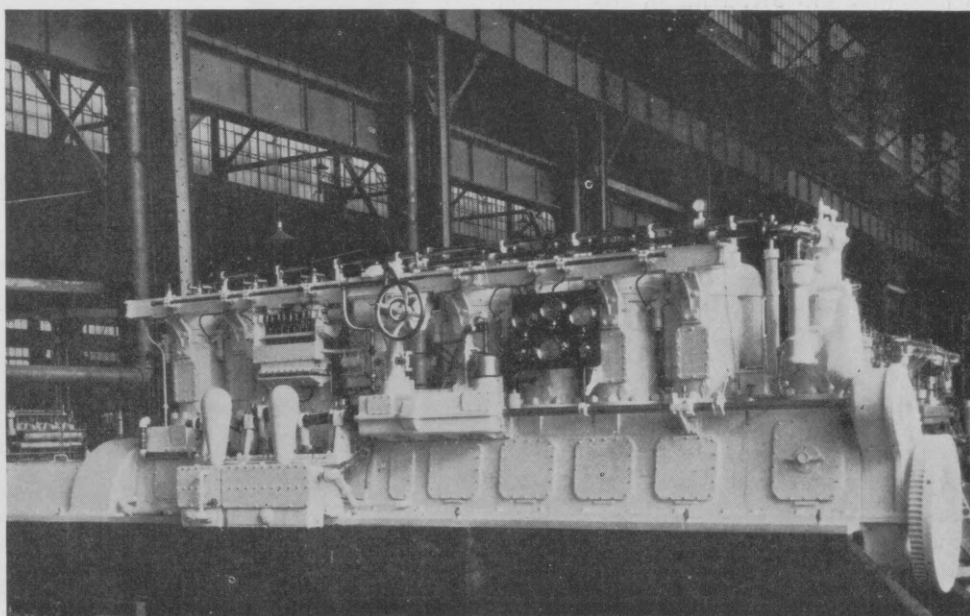
Instead of simply securing a shop right to produce in this country a type of engine already in use abroad, Mr. Winton decided, at the inception of the company, to strike out for original ideas, with the aim of designing and manufacturing an im-

proved and comprehensive line of full Diesel four-cycle air injection marine oil engines. For the first few years of the plants existence, however, large marine gasoline engines were turned out, development of their Diesel engine meanwhile being carried on.

Located on the New York Central Railroad, in Cleveland's busy west-end, the plant of the Winton Engine Works is one of the finest of its kind, both as to the

structure itself and its equipment. The entire plant is of the daylight type—steel and glass, with fireproof roof, and the various units comprising the equipment are up-to-the-minute in design and of proper size to insure efficient and economical production.

The machine shop occupies two of the four main buildings and covers a floor space of 130 ft. by 300 ft. Between the two machine shop buildings are located the water-test department and forge, with adjacent



Another view of Winton engine awaiting shipment at the works



One of the Winton machine shops. An open-side planer is at work on the right

heat-treating room. In one end of one of the machine shops is the rough-stock room,

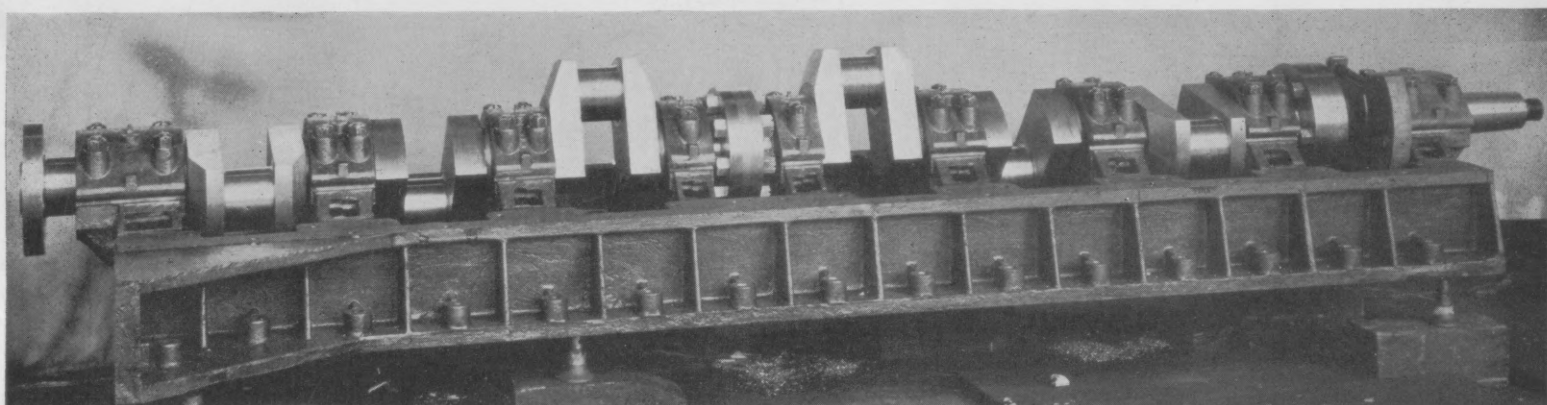
necessary handling and moving by crane. A battery of Lucas mills do practically

bers and shapers, and vertical mills, are also arranged to the best advantage, in order to expedite production. Screw machines and drill presses are also arranged with the same idea in view. The machine shop is equipped throughout with the latest types of special tools, each designed expressly for accuracy and speed in performing its particular work.

From the drills the bases are sent to the horizontal-spindle boring mills. The bearing-seatings for a whole base are all bored at one chucking, so that the bearing-seatings are in perfect alignment.

The assembly department is so arranged that all work can be performed with minimum effort. The heavy parts are all carried direct to the various units on which they go. The smaller parts are assembled on side floors, from where they are carried, either by jib crane or traveling crane, to the engines as they are being erected.

Each unit, when completely assembled, goes to the testing floor, where it is given a most careful inspection, and is required to undergo a prolonged run at full horsepower rating. Slots are provided on stands on



Crankshaft bedded in preparatory to final assembly in Winton engine. From the rough ingot to the finished shaft many special processes of forging, heat-treating, and machining are used. This is an Erie shaft

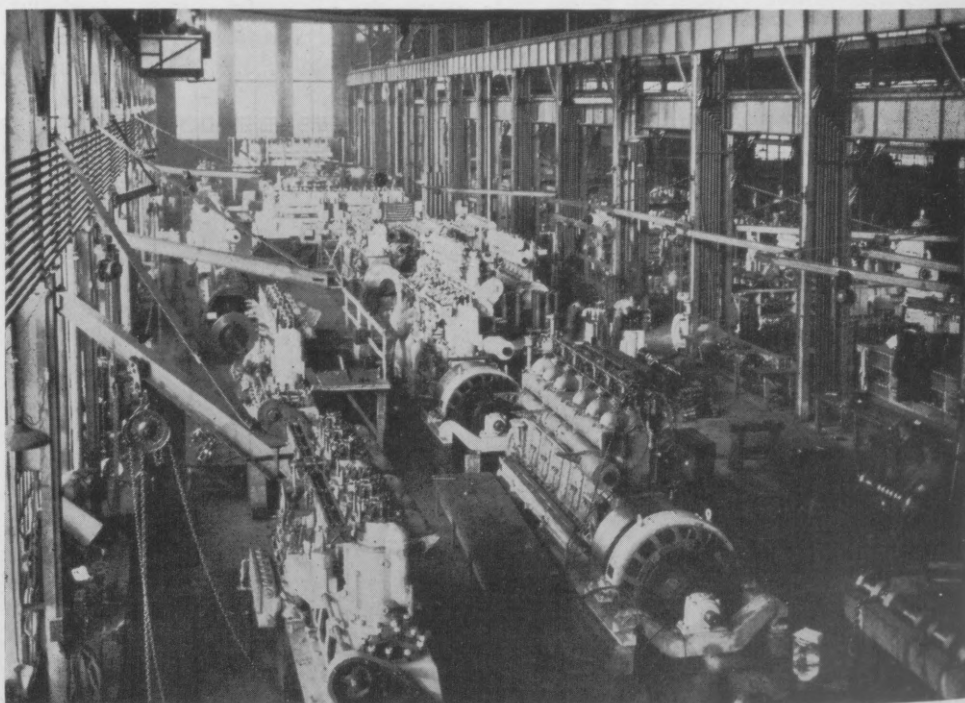
including receiving room. The other two main buildings are occupied by the assembly department, 100 ft. by 360 ft.

At one end of one of the assembly floors is the finished stock room, and above this is located a modern, well-lighted engineering department and drafting room. Separate buildings are given up to the pattern shop, boiler house and sand-blast house. Each of the main buildings is equipped with a crane traveling the entire length of the building, and also numerous stationary jib cranes. The various departments are so arranged that all materials pass through the plant in proper sequence, minimizing handling and insuring speed and economy in operation.

All rough castings requiring hydraulic test are sent to drill presses, from which they go to water-test floor, and from there to layout tables. Castings not requiring this test go direct to layout tables. Heavy castings, such as bases, bed plates, frames and cylinders, go from layout tables to planers. From the planers, these castings are moved by traveling cranes to the radial drill department. Here the parts are drilled and tapped efficiently due to proper arrangement of machines, eliminating un-

all the boring and milling. These machines, as well as the numerous milling machines, engine lathes, cylinder grinders, gear hob-

test floor, so that engines can be bolted to the test bed at any place. Jacket water for engines under test is supplied by means of



Winton engine erecting floor is well-lighted and served both by travelling and stationary cranes

trenches and tunnels, which also furnish and take away the cooling water from the hydraulic dynamometers, on which all Winton marine engines are tested. After the unit has passed its test, it is painted and then lifted aboard the railroad car. All Winton engines are shipped set-up, thereby assuring proper adjustments upon delivery at destination. Loading platforms are on the New York Central tracks, which run into shipping room, located at one end of one of the assembly floors.

The Winton Engine Works builds a line of Diesel four-cycle marine oil engines in two, three, four, six, and eight cylinders, ranging from 50 H.P. to 500 H.P. These engines are suited to various classes of commercial vessels, tugs, lighters, ferries, government boats and yachts.

Notable features of these machines showing clearly the influence of the automotive point of view are the use of dual exhaust and inlet valves and the suspension of the main bearings from the box-frame.

Dual valves are found on a number of high-grade makes of automobile engines and are used because they increase areas and reduce lifts. From what has been written in these pages on the subject of supercharging it is readily enough apparent that anything which improves the supplying of air to oil engine cylinders improves combustion and raises ratings, or if it is desired, permits the use of higher piston and rotative speeds. In view of the increasing import-

ance of the electric drive, the latter has an especial significance.

When high-speed engines are used for direct connection to electric generators, pronounced savings in weight are effected owing to the fact that the higher the speeds at which electric machinery is run, the lighter and less expensive it can be made. Electric-drive is finding increasing applications on our inland waterways because of the marked advantages in maneuvering that can be gained by its use. The numerous installations of this kind to which Winton engines have been applied show that this type of oil-engine is particularly fitted for direct-connection to generators and exciters such as are used to furnish current for the propelling motors of a large variety of vessels.

Special requirements of Diesel engines have been precisely met by the adaptation of automobile engine features. The drafting room as well as the production floor of an efficient automobile plant have both been put to work in the interests of refined oil engine manufacture.

Motorship Construction in a Swedish Shipyard

Not many months ago a license to build Augsburg Diesel engines was secured by the Kockums shipyard, Malmo, Sweden, from the Maschinenfabrik Augsburg Nurnberg (M. A. N.). Since that time this

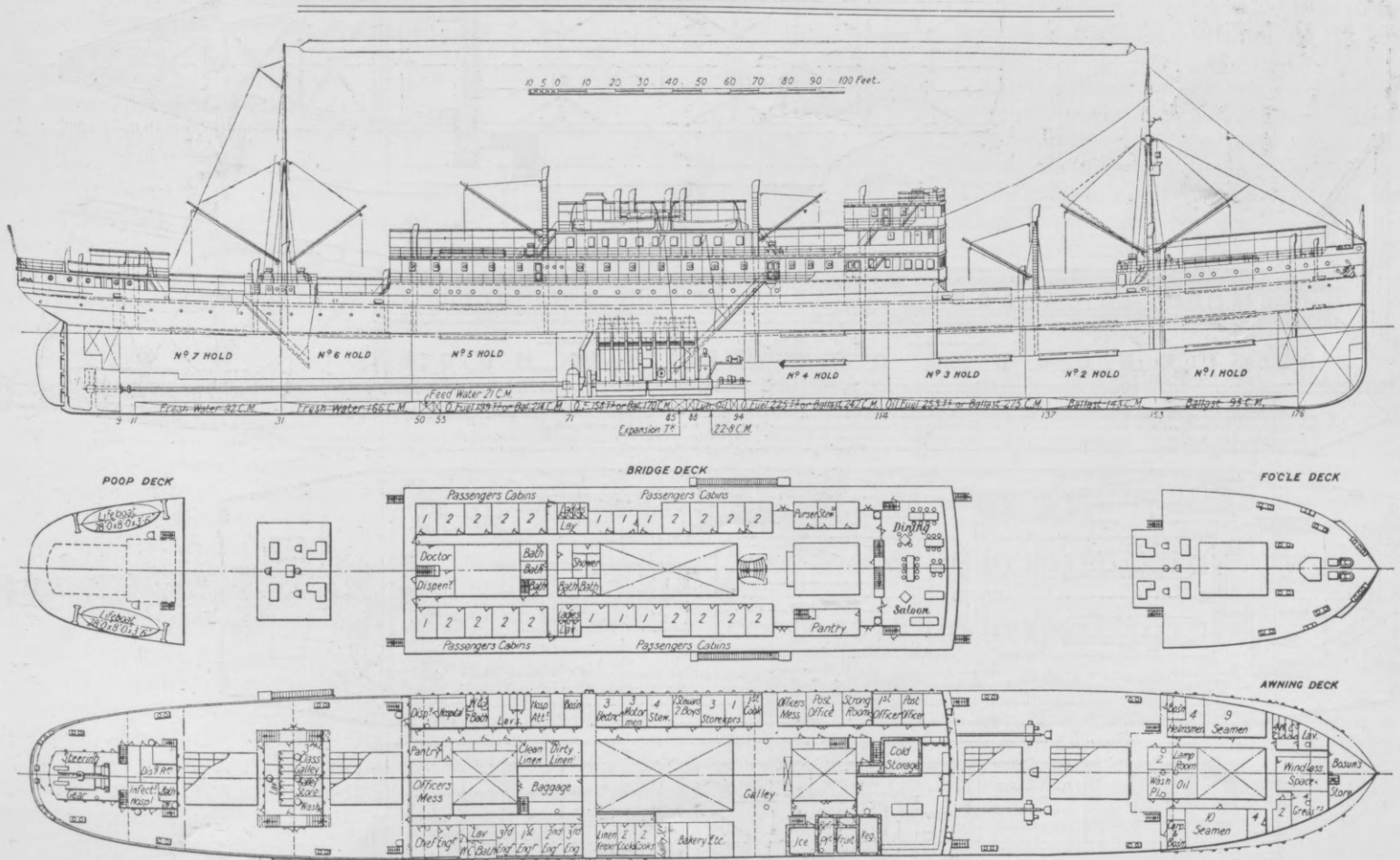
Swedish company has secured orders for three motorships. One of these is a twin-screw motorship of 6,550 tons d.w. building to the order of the North Star Company (Johnson Line) of Stockholm. Her propelling machinery consists of two Kockum-M.A.N. Diesel engines of 1,100 s.h.p. each at 130 r.p.m., which will give her a loaded speed of $11\frac{1}{4}$ knots. Her dimensions are as follows:

Length 367'
Breadth 51' 3"
Depth 34'

The second ship is a single-screw cargo boat of 7,500 tons d. w. building to the order of the Klosters Rederi Co., Christiania, Norway, in which is being installed a Kockums-M.A.N. Diesel engine of 2,000 s.h.p. at 108 r.p.m. This power is intended to give her a speed of 12 knots loaded. Her dimensions are as follows:

Length 375' 8"
Breadth 53' 9"
Depth 34' 10"

The third motorship is also a single-screw freighter of 7,500 tons d.w. and her dimensions and Diesel installation will be similar to the aforementioned ship for the Kloster Company. But she will be built to British Lloyd's classification as will be the twin-screw boat for the North Star Line; whereas the Kloster Company's ship will be constructed to the Norwegian Veritas specifications.



Courtesy "Shipbuilding & Shipping Record," London

General arrangement plans of the motor-driven combination passenger-cargo liners "Esquilino" and "Viminale," building for the Lloyd Triestino S. S. Co., Trieste, at the San Rocco yard. Twin Burmeister & Wain Diesel engines aggregating 3,900 shaft horsepower, built under license by the Stabilimento Tecnico Triestino, Trieste, are being installed. Deadweight capacity 10,000 tons. Dimensions: Length b. p., 450'; length o.a., 467' 2"; breadth, 57'; depth, 35'; draught, 26' 10". Capacity of holds, 573,000 cu. ft. Each carries 40 first-class passengers, has a dining saloon, smoking-room, music-room and reading room. Speed, 13 knots

Large Diesel-Electric Dredge for West Coast

GUIDED by the dredging experience of many years in carrying out the important operations demanded in maintaining an adequate marine road between Portland and the sea, the Port of Portland Commission is adding to its fleet a steel-hull Diesel-electric 30-inch suction dredge that will rank as the largest of its type in the world. In later years the project has been divided so that the Commission concentrates on the Willamette River and the United States engineers operate their floating plant on the Columbia River from the mouth of the Willamette to the Pacific Ocean.

In reaching a conclusion as to the construction of the newest machine, consideration has been accorded to factors that have been wrestled with in the local dredging history to a major extent. It is the design of James H. Polhemus, by whom this account was prepared, for several years general manager and chief engineer for the Commission. Operative and economic features that have marked similar work in other localities have been studied, all with a view to embodying in the Diesel-electric plant ample power, speed in handling material, and endurance. One of the conclu-

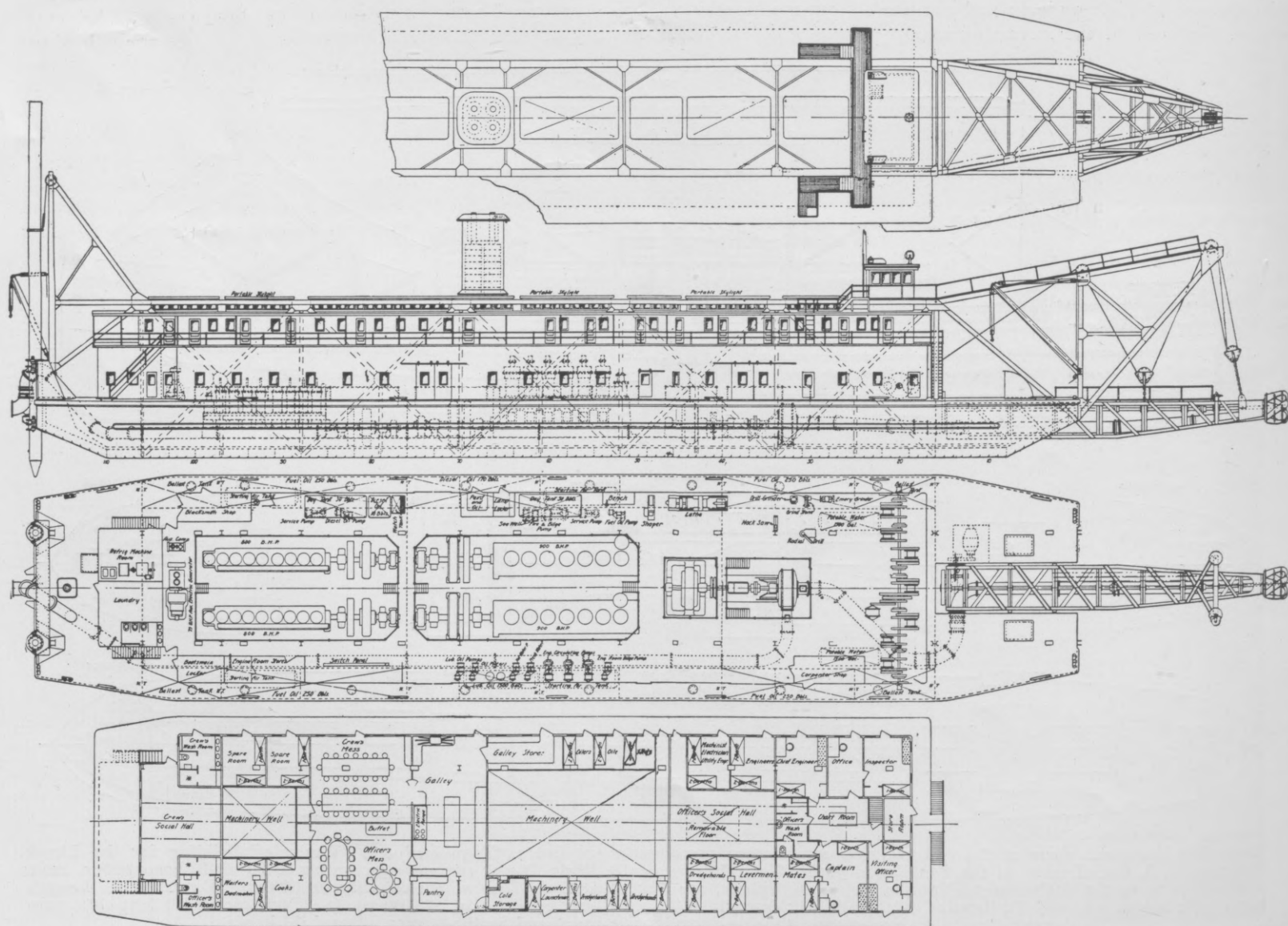
Craft Designed by Port of Portland Commission will have Diesel Engines Developing a Total of 3,400 b.h.p. and will Remove 50,000 Cubic Yards per Day. Fuel Economy of Diesels Yields Valuable Operating Conveniences

sions drawn from these observations was that the necessary speed variations could be had with maximum economy as the result of using electric motors, whose speed could be regulated for all loads with a minimum loss of power. Westinghouse generators and electrical equipment are to be used, the power being developed by four-cycle Diesel engines.

Permanent works in the way of dykes have lessened channel dredging in the district to a large extent. Consequently the present dredging equipment of the Port, which comprises three 30-inch steam-driven machines, has been operated for long periods each season on industrial fills and in the reclamation of lowland areas. This work, of course, comes within the scope of the Port's responsibilities as well as channel work on behalf of commerce and navigation.

gation. Since the material which is required for fills is taken from the channel zone or from dock fronts, the undertakings serve a double purpose.

In former years the Port dredges worked in the Columbia River down to the estuary as well as in the Willamette River, a division of territory which was brought about after the Federal authorities provided suitable equipment and took over the Columbia River section. After summer freshets the rush of melted snow from interior mountainous country is carried seaward bringing with it silt and sand that leaves deposits in certain areas in the Columbia River. The Port of Portland dredges have cooperated with those of the Government for the speedy removal of the resulting shoals. In a year's time, generally speaking, the classes of material handled by the dredge fleet would probably embrace almost every variety of earth formation found in such large rivers, from fine, almost flour-like sand and silt, to heavy sharp sand, gravel, large rocks and even boulders. The latter are not in the channel zone, however, but are encountered at certain new sites for docks and waterfront industries where there had been no previous disturbance of



Port of Portland Diesel-electric dredge has a total of 3,400 b.h.p. Its low fuel consumption makes possible the elimination of wood-fuel barges lying alongside and impeding operations

the deeper strata. In such cases, where the general "lay of the land" produced boulders too numerous or too large for a suction dredge to tackle without danger of serious damage, one of the dipper type is called on.

Comparisons were made on the basis of general types of dredges as well as those which were thoroughly tried out in the Oregon district. As a result of these studies, the Port authorities have centered on a design that embodies features tested out in local operations, but comprises a new type of plant insofar as the introduction of the Diesel electric drive is concerned. It affords abundant reserve to meet the hardest digging and pumping requirements and at the same time permits of the units being so worked out that speed and power can be applied to fit the particular character of the work in hand.

A deciding element governing the choice of Diesel-electric power for the new dredge was its compactness and consequently its ability to effect a saving in hull displacement. Additional considerations, however, were also completely in favor of this type of power and of these the most important was naturally the matter of fuel economy. Steam dredges use "hogged fuel" consisting of fir wood and costing less than \$2 per cord, a fact which brings the economies of the Diesel engine even into more striking relief than do those cases in which exorbitant amounts have to be paid for steam engine fuel. Whereas the percentage saving in the matter of fuel purchase price does not amount to much on the face of things, other costs involved in the consumption by steam dredges of the cheap-to-buy fuel turn the scales heavily in favor of the oil engine.

Other cost items in the consumption of hogged fir besides the purchase price are a large boiler-room crew and the very great expense of maintaining a fleet of barges for handling the bulk fuel, not to mention heavy towing charges involved in conveying them. The barge equipment required under existing conditions on the Columbia river for one 2,000-h.p. steam dredge represents an investment of not less than \$75,000. Adding to the interest charges on this the heavy maintenance cost of barges and a 10-year depreciation pads the bills for fir fuel to such an extent that the Diesel engine costs are far below them.

An additional factor which raises the real price of hogged fir high above its apparent price of \$2 per cord is that the supply of it is not always to be depended upon in severe winter weather when logging camps and saw mills shut down for their annual overhauling. Owing to the fact that the wood is bulky and deteriorates rapidly when stored under the conditions incident to steam-dredge operation, the provision of a reserve supply for a migratory plant is not a practicable proposition.

Freeing the dredge from impeding barges and from handling gear alongside greatly increases output, so that if the monetary gains due to this alone were to be subtracted from the Diesels' fuel bill, there

would be an inverted balance. Since the Diesel-electric dredge carries at least a thirty-day supply of oil in tanks conveniently located on board, it is entirely self-contained. A steam dredge, on the other hand, can never get along with less than one barge alongside, as the result of which the width of the plant is practically doubled and it is rendered incapable of operating in narrow places such as pier slips. For working in currents, particularly those due to tides and freshets or for dredging in waters

operation alone requires the better part of two days and in addition to that tubes and shells must frequently be thoroughly scaled and numerous replacements of tubes and staybolts are unavoidable. All of these things involve a considerable loss of time, not to mention the maintenance of a large boiler-room force which they make necessary.

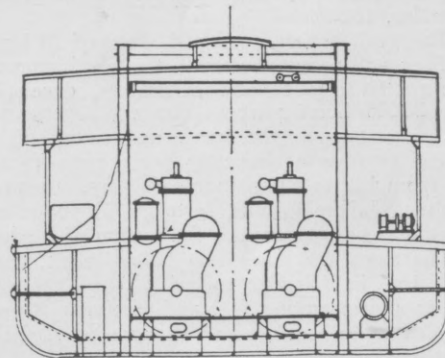
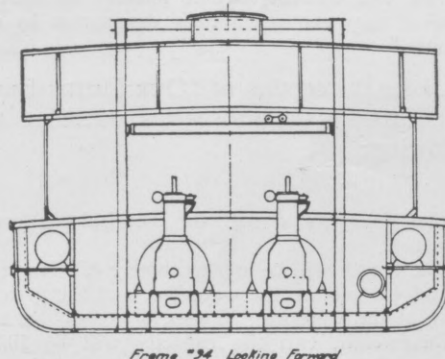
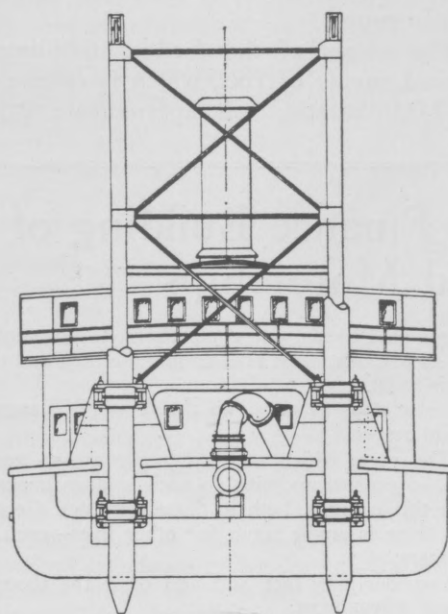
In reaching the decision to adopt the Diesel-electric drive serious consideration was not given to a proposal for operating with purchased electric current because of the fact that the dredge is working far away from transmission lines most of the time. Tentative plans are being made for arranging the electrical units in such a way that purchased current can be used if it is available, but the decision in this regard will only be finally made after actual operating results are at hand to show what the cost of Diesel-generated current is. To judge by the comparisons reported in almost every issue of our associated journal, *Oil Engine Power*, on the subject of purchased power versus Diesel power, the provisions for the use of outside current on this Port of Portland dredge will have no very great practical significance. We hope to have an opportunity, after the boat goes into commission, of giving a full report on the cost of dredging and pumping current which will be incurred and to judge from many observations previously made it will be a good deal cheaper to generate electricity by means of the Diesels than to purchase it from land sources at the lowest rate for which it can be had.

Direct current will be generated by four large McIntosh & Seymour Diesel engines direct-connected to Westinghouse dynamos having an aggregate power of 2,350 kw. There will be two 800-b.h.p. and two 900-b.h.p. Diesels and the four units will be wired to the switchboard in such a way that all power requirements, from the largest to the smallest, will be capable of being economically met.

The main dredging pump is designed to be made of exceptionally heavy cast steel and will be direct connected to a 2,700 h.p. variable speed constant power motor, having a speed reduction or regulation from 250 to 360 r.p.m. Through the speed reduction provision, discharge pipe lines varying from 1,000 to 7,000 feet in length may be served with the one size of impeller.

The ladder is to be of structural steel, fitted with heavy cast steel swinging trunnions at the inner end and a revolving cutter at the outer end. The cutter will be of the spiral type, made of cast steel and will be fitted with special knives for cutting hard material. Power for turning the cutter shaft will be furnished by a 250 h.p. variable speed constant power, heavily built motor. The latter will be installed inside the hull and connected to the cutter shaft through a series of reduction gears.

There are to be three separate winches, one for swinging the dredge, one for raising the ladder, and one for lifting the spuds. The two latter hoists will be oper-



End views of Port of Portland dredge, the "spuds" for holding it in place while working being shown at the top

disturbed by high winds or the swells of passing steamers, the extra width of the wood-fuel barge or barges (two are sometimes necessary) are a serious impediment.

Probably the most troublesome element in a steam plant is the boiler and furnace installation. Not only do the furnaces and boilers require frequent overhauling, but they must be allowed to cool down for cleaning not less than twice a month. This

ated by 45 h.p. direct current series wound motors direct connected to winches by means of suitable reduction gears.

The swinging winch will have a 75 h.p. motor and variable speed will be obtained by means of the well known Ward-Leonard system. All three operations, lifting the ladder, swinging the dredge, and raising the spuds are independent.

All of the clutch and brake controls will be electrically operated from the lever room or pilot house.

All the winches will be of our design and heavily built of cast steel construction.

The spuds are to be of steel, 35 inches in diameter and 80 feet in length, installed in wells at the rear of the dredge sup-

ported by heavy steel brackets with cast steel keepers.

The design of the hull is adapted to take the weight of the Diesel engines. Heavy steel trusses have been designed to afford increased longitudinal strength. To make the hull virtually non-sinkable it will be divided into a number of watertight compartments. Four longitudinal and four transverse bulkheads are provided with fuel bunkers outside the longitudinal bulkheads. They will have a capacity of 3,000 barrels of oil, which is estimated to be a 30-day supply.

The weight of the dredge, including a normal supply of fuel, which is calculated at 1,000 barrels, will approximate 2,300

tons. In average good material it is figured the machine will handle 50,000 cubic yards in a 24-hour day.

The matter of comfortable quarters for those aboard has been well taken care of. Besides the usual features in the living quarters many new ones are to be added, such as the galley being equipped for electric cooking while a refrigerator plant will be another welcome adjunct. There will be a well equipped laundry and a social hall.

Shops on the main deck for machine work, blacksmithing and carpentering, will have power tools operated by separate electric motors. The Wallace Equipment Company of Seattle has been awarded the contract for building the steel hull.

Corporation Promoted to Finance Building of Oil-Vapor Engined Motorships

INFORMATION has been submitted to us for publication by the promoters of a concern known as the New York and West India Mail Company which proposes to sell securities to the general public for the stated purpose of constructing four motorships to be powered with oil-vapor engines of a radically new type.

Edward L. Temple is temporary president, Alfred C. Brown acting treasurer and Alvin E. Rice, ad-interim assistant treasurer, permanent officers will be announced later. The concern is at present occupying desk room in the offices of the Dingwall Oil Producing Corporation, Room 1932, 17 Battery Place, New York City.

A campaign will be undertaken to sell securities on the following plan:—

"The bond issue, amounting to \$2,500,000, consists of 10 year 7½ per cent sinking fund debenture gold bonds; and to secure it the company agrees to execute and deposit with its trustee a second mortgage covering the four ships as soon as these ships are delivered to it by the builders.

"The bonds are issued in three denominations, \$100, \$500 and \$1,000, with interest at the rate of 7½ per cent per annum, from and after July 1st, 1925.

"The bonds mature on July 1st, 1934, but may be called in whole or in part and be prepaid at par and accrued interest on any interest date on and after July 1st, 1926. The sinking fund provisions will secure the payment of the entire issue at or before maturity."

Because engineers familiar with the problems attending departures from accepted practice in design will be interested in the revolutionary methods which it is proposed to make the basis of this flotation we quote at some length from the profusely illustrated colored prospectus which describes the plant to prospective investors.

"The New York & West India Mill Company has been organized to own and operate ocean-going motor-electric ships.

"It has contracted for the building of four large fast express ships, more efficient in almost every way than any vessel afloat.

"The operating expense per ship at the most will be but 70 per cent of that of the ordinary ten or eleven-knot oil burning steamer; and our four ships will easily do the work of eight steamers.

"Therefore, for every \$2.80 in operating ex-

penses paid by us, our competitors, to accomplish the same work, must take double the time and disburse \$8.00.

"Such ships as ours can thrive where steamers would starve.

"The ports which we shall serve are so populous, so prosperous, and do such a large business with this country, both in passengers and freight, that there is ample room for other lines—even of steamers.

"Consider this fact and add to it the thought of our advantages.

"Few will consent to take passage on another vessel if they can reach their destination by one of ours."

Under the caption of "OUR MOTOR-ELECTRIC SHIPS," the prospectus publishes the following:

"The Hulls:

"The four ships will be identical in every respect.

"The length will be approximately 452 feet over all and 400 feet on the waterline, and the greatest width at the waterline, 75 feet.

"Deadweight carrying capacity will be 10,750 tons and total displacement when loaded to load waterline, 13,550.

"They will have a sustained speed of 20 knots.

"They will be supplied with the most improved type of oil engines and generators, developing over 20,000 horse-power. The eight generators will, according to the latest and most efficient system, revolve horizontally from right to left and from left to right, four each way, instead of revolving in the manner formerly in vogue and which may be compared to the motion of a wheel.

"The ships will have two hollow keels, about eight feet in diameter spaced 32 feet apart on centres and extending fore and aft for a distance of 240 feet. There are to be twin screws, one at the after end of each hollow keel.

"These hollow keels, combining as they do the advantages of bilge keels and centreboard and much accentuating them, will, it is claimed by many eminent marine authorities, make ours the best sea boats of their size existent.

"In a cross sea our ships will roll less than any others, not only on account of the keels, but also because the eight generators will act the same as that number of gyroscopes, tending to keep the ships upright at all times. This not only helps the speed but adds greatly to the comfort of passengers in rough weather.

"The propellers, being under water all the time, whether the ships are loaded or not, will work always under the best conditions projecting solid columns of water into solid masses of water and increasing propulsive efficiency. The power ex-

erted produces the maximum results, and there will be practically an entire absence of vibration."

As an aid to understanding those of the statements in which gyroscopic action from the high-speed generating sets is mentioned, the reader is briefly reminded of the essentials of gyroscopic ship stabilization as hitherto generally accepted. In order that a rotating body may actually exert its gyroscopic effort in a way that is effective, the bearings must be free to turn also, and about some axis generally at right angles to their own centerline. Consequently the gas-electric generating sets of the proposed ships must be mounted on pivoted bedplates in the same way that a ship stabilizing gyroscope is mounted on gudgeons. All piping must be swiveled and packed and the electric connections established through commutators or articulated leads.

According to verbal information given out at the office of the Dingwall Oil Producing Corporation, by the acting president of the N. Y. & W. I. Mail Co., fuel oil for the engines is first to be heated in the jackets of the cylinders and the oil thus circulated is to act as the cooling medium. After leaving the jackets the fuel oil is further heated to an extent which, it is alleged, will completely gasify it and render it suitable for use in internal combustion machines of the gas engine type. Presumably light-weight high-speed engines are contemplated which will draw in and moderately compress gas and air mixture to be subsequently ignited by an electric spark. Seventy working cylinders are to be employed in this hypothetical power plant and will be used for driving electric generators to furnish current for propelling motors located in the hollow keels.

A remarkable engineering advance is implied by the information given out in regard to the use of oil vapor in a machine running on the gas engine cycle. Because of the great variety of ingredients that constitute ordinary fuel oil, attempts to gasify it have hitherto been successful to a limited degree and our close touch with the oil engine field has not as yet yielded any data on a stationary internal combustion plant running on oil gas other than vapor from gasoline, kerosene, or distillate.

Pacific Shipper's Maiden Voyage to Pacific Coast

THE Furness-Withy Co.'s new Doxford engined motorship, **PACIFIC SHIPPER**, arrived at Vancouver, B. C., on her maiden voyage on April 30th last, just over a month out from Manchester, which she left on March 28th, having logged about 8,700 nautical miles.

Some days of rough weather were met on both Atlantic and Pacific; and as the vessel was comparatively light, drawing 17 feet of water with 1,500 tons of cargo on board, the engine and governor had a thorough tryout under propeller-racing conditions. Chief-Engineer W. Collier reports that her engine performed very satisfactorily. An average speed of 11.8 knots was maintained, 2,800 s.h.p. being developed, the engine being run at an easy speed in order to work it in. The only stop on the trip out was made at Balboa, Panama Canal Zone, where she arrived on April 15th, leaving again on the 17th, and arriving at Vancouver, B. C., April 30th. The chief states that when the cylinders were opened for inspection at Vancouver they were in splendid condition.

The dimensions of the **PACIFIC SHIPPER** are as follows:

Cubic capacity of holds and 'tween decks	543,280 cu. ft.
Capacity of deep tanks	1,900 tons
Capacity of double-bottom fuel bunkers	1,100 tons
Deadweight capacity	9,500 tons
Fresh water (domestic)	30 tons

Her Opposed-Piston Engines Handle Well in Spite of Heavy Seas; Continuous Centrifugal Fuel Oil Purification Left Cylinders in Excellent Condition

(By our Vancouver Correspondent)

Fresh water (Donk. Boilers) ..	42 tons
Shaft horsepower	2,870
Indicated horsepower	3,500
Daily fuel-consumption at 83 r.p.m. (12 knots)	10 long tons
Lubricating oil-consumption for main and auxiliary machinery	13 gals. per day
Daily fuel-consumption of steam plant in port	2 tons
Engine speed	87 r.p.m.
Trial speed	13.85 knots at 92 r.p.m.
Expected loaded speed	12.5 knots
Cruising radius	24,000 miles at 12 knots
Propeller	15' dia., 17' pitch and 90.8 sq. ft. area
Weight of main engines	375 tons
Length of machinery space	43'
Total length of engine-room (not including thrust recess)	50'
Number of engine-room crew	13 men
Bore and Stroke of main engines (4-cylinder, 2-cycle) ..	22¾" by 45"
Combined stroke of opposed pistons	90"
Length b.p.	420'
Breadth, moulded	58'
Depth, moulded	28.1'

Loaded draft 26.9'
 Classification Lloyds A1
 Owners.....Furness Withy & Co., Ltd., London
 Builders.....Wm. Doxford & Sons, Sunderland

This motorship has a number of decidedly interesting features, largely developed through Furness, Withy & Co.'s experience with their motorship, **DOMINION MILLER**, the first of their fleet to be equipped with Doxford opposed piston engines. Not the least point of interest is that the **PACIFIC SHIPPER** with practically the same sized four-cylinder engine, with the same bore and stroke, as the **DOMINION MILLER**, has 400 i.h.p. more; the m.i.p. having been increased from 76 to 87 through successfully burning a larger amount of fuel, the fuel injection pressure having been raised from 3,000 to 4,000 pounds.

The new vessel has been built with good lines for speed, having a very fine run aft, for this class of ship. She was constructed by Wm. Doxford & Sons, Ltd., at Sunderland, the same company being the engine builders. The arrangement of her superstructure shows a nicety of balance that compares favorably with the fine types of motorships of this class being developed by other companies. Though primarily a freighter she has comfortable accommodation for 12 first-class passengers. The engineers' cabins however have been considerably cramped in the design, the chief's



Opposed-piston engines have propelled this ship on a successful maiden voyage to the Pacific Coast

room being so small that he had to annex a cabin, intended for the third engineer, to use as an office, and keep various instruments, etc., for which there was no room under the berth in his own room.

Considerable attention has been paid to refrigerating spaces for fruit, and other cooled or frozen cargo, as well as the general arrangements of the cargo holds.

A feature of the double bottom construction is a duct keel, a vertical inside keel of box shape extending forward from the engine room and forming a watertight passage between the double bottom tanks. The fuel, ballast and bilge water pipes are led through this passage, where they are always easily inspected; while manholes of the double bottom tanks also open into it.

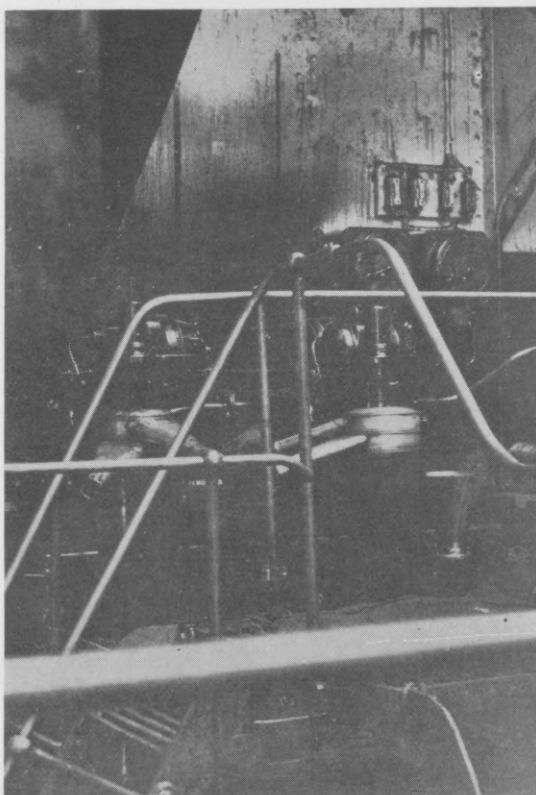
The Doxford opposed-piston engine is practically the same as the one in the DOMINION MILLER, being a 4 cylinder 2 stroke power plant with a bore of $22\frac{3}{4}$ inches and 45 inch stroke for each piston, or a combined stroke of 90 inches for the opposed pistons. It develops 3,500 i.h.p. or about 2,870 s.h.p. at the ordinary speed of 87 r.p.m.; though on the trial trip it is said to have developed 4,000 i.h.p. or 3,280 s.h.p. when opened up to 93 r.p.m., 1,000 i.h.p. being the largest power per cylinder yet attained in any motorship now in commission.

Particular care is taken in regard to circulating water for the cylinders, this jacket water being maintained at a constant temperature of 160 degrees Fah. Distilled water is used, and in addition a special compound is added which has the effect of preventing rust and scale. The water jackets are heated by the introduction of hot water before the engines are started up.

Fresh air for scavenging, which is supplied at a pressure of about two pounds to the square inch is taken down through a shaft from near the engine-room skylight to the scavenging pump, which is an additional cylinder working off the main crank shaft, and placed between No. 2 and No. 3 working cylinders.

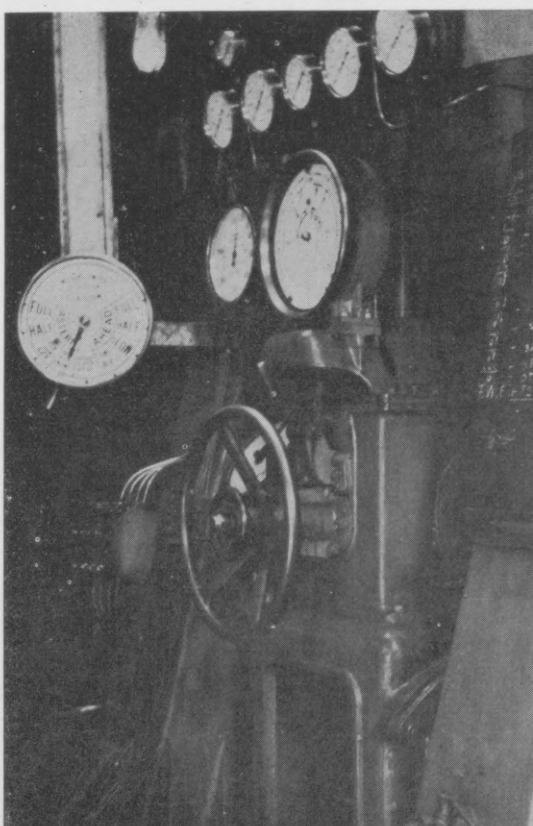
The main engine works on a compression of 300 pounds to the square inch, the fuel being mechanically injected at a pressure of 4,000 pounds; while the maximum pressure of the combustion is 570 lbs. per sq. in. Starting and maneuvering is accomplished by introducing compressed air to one cylinder at a time. The air bottles are charged to 600 pounds, and Mr. Collier states that a quarter of a turn of the engine on air is sufficient as a rule before changing on to fuel, this being effected with the loss of as little as 10 or 15 pounds pressure in the air bottle. He also says the engine will start up as easily at 20 r.p.m. as at full speed, the range being from 18 to 87 r.p.m. normally, though it will do as high as 93 r.p.m. when opened up.

The Aspinall governor was given a good try out on the passage during rough weather, when on account of the ship being light the propeller raced a good deal. The governor was usually set to check the engine at about 93 r.p.m. It is said to have been effective.



Centrifugal oil purification contributed to the success of the "Pacific Shipper's" maiden voyage

Two Sharples 500-gal. per hour centrifuges for fuel-oil purification are a feature in the engine room of the PACIFIC SHIPPER. The separators deal with fuel oil in such a manner as to eliminate water and a large part of the other undesirable contents. In the DOMINION MILLER boiler oil was used after heating it and passing through settling tanks; but on the PACIFIC SHIPPER all settling tanks are done away with. One of these centrifuges is a stand-by machine used for purifying the lubricating oil though either of them can handle all of the puri-



Simple control station on "Pacific Shipper" insures accurate and safe maneuvering

fying alone in the rare case of accident to the other one.

Fuel oil on its way to the centrifugal purifier is steam heated to a temperature of 130 degrees. It is then subjected to a centrifugal whirl of 17,000 r.p.m. which eliminates the water and a large portion of the ash and non-combustibles. The purified oil then passes through a weighing machine, which keeps an automatic record, and passes the oil on to the reserve tank from which the engine takes it. This reserve tank is fitted with steam pipes by which the temperature of the oil can be kept up if necessary. On the trip out to the Pacific an Anglo-Persian oil fuel of about 22 degrees Beaumé was used. This oil passed through the centrifuge yielded about a pound of refuse every four hour watch; and Mr. Collier states that the advantage of this purification was evident in the splendid condition of the cylinders when they were opened up at Vancouver. On the return trip the PACIFIC SHIPPER will fuel up with boiler oil at San Francisco as it was mainly to use this type of fuel that the centrifugal purifier was installed.

The total length of the engine room is 50 feet, not including the thrust recess which is utilized as a workshop. The space taken up by the main engines is about 43 feet.

Steam for auxiliaries and deck machinery is supplied by two oil-fired boilers in separate compartments on either side of the engine room. A Cochrane boiler with 1,600 sq. feet of heating surface operates the auxiliary machinery, when the large refrigerating plant is not in operation, on a fuel consumption of about two tons a day; while a Hawthorne Lister Scotch boiler with 1,830 square feet of heating surface can handle alone both auxiliaries and refrigerating plant on a fuel consumption of between 3 and 4 tons.

Two compound engines of the enclosed type with forced lubrication drive generators of 30 k.w. each, electricity being used besides lighting for driving the cold air fans of the refrigerator plant, for a 7-ton travelling crane in the engine room.

The auxiliary machinery is practically all in duplicate, or else in the case of some pumps they are interchangeable for different duties. There are two sets of four fuel-injection pumps, one set working off the main shaft at the after end of the engine, and the other driven separately by a steam auxiliary is on the starboard side abreast of the engine controls. Two three-stage Weir air compressors, also on the starboard side, are available either together or separately for pumping up starting air in two large bottles, tested at 800 pounds pressure, and normally charged to 600 pounds. Other auxiliaries on the starboard side of the engine are two bilge pumps with a capacity of 60 tons an hour each, one very large ballast pump with a capacity of 300 tons an hour, fuel transfer pumps, water circulation pumps and forced lubrication pumps and filters. On the port side are the CO₂ refrigerating machines and the generators with their engines.

There are 143,000 cubic feet of insulated space in the holds and the refrigeration system is a cold air one primarily designed for the carrying of fruits at an even temperature. The cold air supply is controlled by fans and a complete change of air in the refrigeration compartments is possible without changing temperature. An experimental shipment of bananas was taken on at Balboa and kept at a temperature of 50 to 55 degrees. When opened up at Vancouver after 17 days the fruit was considered in excellent order by the produce merchants who inspected it. On the return trip a shipment of fruit will be taken on at San Francisco. The refrigeration plant consists of CO₂ machines with a capacity of 200,000 cubic feet of space. In the forward part of the ship the lower hold, tween deck, upper tween deck and butter room are insulated. Refrigeration space is also provided for the ship's supplies.

Besides refrigerating space provision has been made for carrying grain; fittings in accordance with the requirements of the Pacific Coast ports having been introduced. The after holds have permanent fore and aft partitions, except in the way of the hatches where the girders and stanchions are slotted or grooved to receive shifting boards, the necessary additional bracing also being provided; while all the planking

necessary for feeders is carried, numbered to fit.

The writer had an opportunity of observing the great flexibility of control of this engine while manoeuvring, on invitation of the Chief Engineer, while the PACIFIC SHIPPER was shifting from one wharf to another at Vancouver under her own power.

The engine being cold the water jackets were first heated and the main engine turned over slowly by a small steam auxiliary driving a cog wheel on the main shaft through a worm gear, in order to make sure that everything was working clear. The auxiliary fuel injection pumps were then started and worked up a pressure of 6,000 pounds, which is the pressure used for maneuvering; and one of the air compressors was started to maintain pressure in the air bottle that would be used for starting and maneuvering.

From the response to the first telegraph order from the bridge it was apparent that the engine was under remarkable control, giving due credit to the Chief Engineer for his expert judgment of the amount of air required before switching on to fuel.

In a series of maneuvers so numerous that no record was kept after the first few at the start, but apparently involving turning the ship around by going first ahead and then astern and repeating this frequently,

after she had worked clear of the wharf; the indicator on the starting air pressure gauge rarely fell from 500 below 450 pounds even after a series of rapid changes; 375 pounds is said to be sufficient air to start on, after dropping to which, there is the other air bottle and second air compressor in reserve. However, the one bottle with one compressor working was ample. Usually a maneuver only showed a loss of 10 or 15 pounds on the gauge.

The average time from the order till the engine was working ahead or astern on fuel was two or three seconds, and the order to stop was also carried out in about three seconds; while six seconds seemed to be the average time involved in reversing under ordinary working conditions; though the Chief Engineer stated that this time could be materially reduced if necessary.

Where the order was for slow the engine was started up at between 20 and 30 r.p.m., immediately coming down to 18 or 20 r.p.m. if necessary. These slow revolutions were available even where just a kick ahead or astern was required.

The PACIFIC SHIPPER is taking 3,000 tons of grain from Vancouver and will pick up other cargo, including fruit at various ports on her way down the coast. She will be followed to this coast shortly by a sister ship, the PACIFIC TRADER.

Interesting Notes and News From Everywhere

A STEAMER of 7,500 tons deadweight has been purchased from the Shipping Board by Atlantic Refining Co. for conversion to Diesel power.

Swan, Hunter & Wigham Richardson, Ltd., have orders for oil engines for twelve motorships, of which ten will have Neptune Diesels.

HALAL, a twin-screw motorship of 300 tons dw., built to the order of the Halhal Shipping Co., London, by Bow, McLachlan, has run trials.

The name of the Marine Engineer & Naval Architect of England has been changed to the Marine Engineer & Motorship Builder. A sign of the times.

VEDETTE is the name of the big Diesel-driven yacht building at Burmeister & Wain, Copenhagen, to the order of F. W. Vanderbilt, of New York City.

CITY OF SAN FRANCISCO, one of the two motorships building for the Pacific Mail Steamship Company, has been launched at the Götaverken, at Goteborg, Sweden. Pictures on another page.

When on a return trip fully loaded, the motorship CUBORE recently passed through the Panama Canal in ten hours, or nearly

World's Record of New Construction, Ships' Performances and Other Matters of Note in the Motor-Vessel and Oil Engine Industries

five hours better than her sister reciprocating and turbine steamers do.

According to the Department of Commerce at Washington, D. C., the Hamburg-America Line now owns 35,876 gross tons (about 57,000 tons d.w.) of motorships, and 348,858 gross tons of steamships.

For their Australian service the Commonwealth and Dominion Line of London has ordered an 8,500-ton motorship from Workman Clark, of Belfast. A Doxford opposed-piston type oil engine will be installed. This Line has also ordered a motorship from Swan, Hunter & Wigham Richardson, Ltd.

A number of back copies of MOTORSHIP from June, 1918, to December, 1922, are held by J. W. Anderson, 281 So. Columbus avenue, Mount Vernon, N. Y., who is willing to dispose of them to anyone who needs the same.

The first 450 b.h.p. Vickers-Petters oil-engined tug for the Port and Lighthouse Administration of Alexandria, Egypt, is

practically completed at the J. Samuel White yard, East Cowes, and the second has just been launched.

Will Jim McNeil send us his correct address as a letter and copy of MOTORSHIP sent to him care P. & R. Station No. 2, Parco, Wyoming, has been returned unclaimed. Consequently, his subscription to MOTORSHIP has not been entered.

According to Lloyds, the total number of motorships building in countries other than the British Isles, on March 31, 1924, was 99 ships, aggregating 369,522 gross tons. This makes a grand total for the world of 154 vessels, aggregating 694,712.

An 85-ft. motor yacht, namely the SEADRIFT, to the order of C. G. Somerville, of Greenwich, Conn., was launched at the yard of Livingston & Cooper, Hull, England, on April 21st. Twin Mianus oil-engines are installed as auxiliary power.

Swan, Hunter & Wigham Richardsons have launched the motorship KOLA, sister to the motorship KISTNA. Both are owned by the British India Steam Navigation Co., are single-screw vessels of 2,000 tons d. w., and have Neptune Diesel engines.

Among the new construction previous-

ly referred to as building at the Stabilimento Tecnico Triestino of Trieste include a 10,300-ton carrying capacity motorship propelled by twin 1,200-b.h.p. Diesel engines. The dimensions of this ship are 445 ft. x 57 ft. x 33 ft.

An order for a Diesel-driven freighter of 7,500 tons d.w. and 3,400 i.h.p. has been placed with the Götaverken, by the Swedish East Asiatic Co. The same yard has secured an order for a Diesel freighter of 5,000 tons d.w. and 2,000 i.h.p. Götaverken, B. & W. Diesel engines will be installed in each case.

Wilhelm Jebsen, of Tonsberg, Norway, has ordered a 10,500-ton Diesel-driven tanker from Armstrong, Whitworth & Co., Newcastle. It is expected that another order for a 13,000-ton Diesel-driven vessel will be placed by Scandinavian owners in Great Britain very shortly.

Recently we commented on some remarks made by Sir James Redhead, English shipbuilder, as not being helpful to motorship development. It is interesting to note that our British contemporary, *Syren and Shipping*, virtually endorse our remarks in its issue of April 9th.

Lloyd's shipbuilding returns for March 31st, 1924 gives the number of motorships under construction in Great Britain at that date as 55 aggregating 325,190 gross tons, which is within 2,000 tons of the aggregate tonnage in Great Britain for December 31, 1923. But these figures are nearly double the tonnage under construction one year ago.

The Kockums Mek Verksted, at Malmö, Sweden, have received an order for two motorships from two of the Dan Brostrom Companies, including one from the Tirfing Company, of Göteborg, which will be a single-screw vessel of 7,500 tons d. w. and 2,600 i. h. p. The Diesel engines will be built at the Kockums Shipyard, which recently acquired an Augsburg license.

According to the annual report of the Wm. Cramp & Sons Ship & Engine Bldg. Co., Philadelphia, Pa., their subsidiary the De La Vergne Machine Co., of New York, has completed the most satisfactory year in its history and the business has given every indication of substantial growth. There is a prospect of continued demand in reasonable volume for De La Vergne stationary oil-engines.

BELDIS, a 3,350-ton deadweight motorship designed for locomotive transportation was launched on April 5 at the shipyard of Armstrong, Whitworth & Co., of Newcastle. Her dimensions are 292 ft. x 45 x 21.5 ft. and she will be powered by a single 4-cylinder 2-cycle Armstrong-

Sulzer Diesel engine developing 1,350 h.b.p. at 110 r.p.m. with bore and stroke dimensions of $23\frac{5}{8}$ x $41\frac{5}{8}$. Delivery is being made to the Christian Smith's Company.

A list of motorships and marine oil-engines recently ordered abroad by Americans was published on page 266 of our April issue. This list included four motor-vessels building for the Roosevelt Steamship Co., of New York, namely the SILVERELM, SILVERPINE, SILVERLARCH and SILVERCEDAR, and were quoted as being powered with Neptune engines. However, the SILVERELM and SILVERCEDAR are building at Doxfords and will have Doxford-opposed-piston oil-engines.

Furthermore, the list, which we stated was not complete, did not include three additional motor tankers of 3,750 s.h.p. each, for Standard Oil interests. Also hulls No. 470 and 471 for Standard Oil interests have engines aggregating 3,750 s.h.p. instead of 2,650 s.h.p. as quoted. Nor did our list include the Doxford motorship SILVEROAK, building for the Roosevelt Steamship Co. This means that the total horsepower on order is increased from 47,830 to 63,500.

Trials of the motorship FREM were recently run in Denmark, and the vessel has now been placed in daily coastwise service from Copenhagen to the Island of Bornholm, by the Bornholm Company. This vessel is of 400 tons d.w. and has sleeping accommodation for 230 first-class passengers, and a cruising capacity of 7,500 miles. Her contract speed of 13 knots was exceeded. Compared with the owner's steamship HEIMDAL, the FREM has accommodation for 35 per cent more passengers and 15 per cent additional cargo. Her main engine is a Burmeister & Wain Diesel of 1,150 i.h.p. together with Diesel-electric auxiliaries for the electric engine-room and deck machinery. Detailed story next month.

The Danish Court of Appeal has awarded E. O. Jorgensen of New York, formerly of Burmeister & Wain, the sum of 40,000 kroner with interest, apart from the 5,000 kroner previously paid to him in connection with patents on Diesel-engine design. The patent rights remain the property of Burmeister & Wain.

British Columbia Workboat Notes

Hodder Bros. of Vancouver, B.C., owners of the tugboat HUSTLER, are having a new tug built by A. Moscrop, which will measure 63 feet o.a., 15 feet 6 inches beam, and will be equipped with a 3-cylinder Union Diesel engine developing 110 h.b.p. at 280 r.p.m. Stroke and bore dimensions are $10\frac{1}{2}$ in. by 15 in. and will be supplied through the Burrard Iron Works of Vancouver. It is the 4-cycle type, using mechanical injection of fuel, and has a hot compression of about 320 pounds to the square inch. A Coolidge three-blade propeller of 58 inch diameter and 44-inch pitch will be used. This tug is being built

of fir, with heavy sawed frames, and is of a very suitable type in which to install an oil-engine weighing about 20,800 pounds net. She will be used for general towing, the propeller having been chosen with a view to handling heavy booms of logs.

H. A. Jones of Vancouver, who is fast building up a fleet of oil-engined tugs, has decided to install a 100 b.h.p. 4-cylinder 4-cycle Washington-Estep Diesel in place of a 62 h.p. engine in the tug ATTA BOY, 58 ft. o.a. by 13 ft. 6 in. beam. She will be used for general harbor and coastwise towing. A new hull will be built for the old engine, which is a Penney-Porter.

Mr. R. P. McLennan's power cruiser MAC & MAC returned to Vancouver early in May after a 2,500 mile trip as far north as the Naas river. It was her first trip after having a 40 b.h.p. Atlas-Imperial Diesel installed. The MAC & MAC is about 47 ft. o.a. and 12 ft. beam. She is reported to have made 9.7 knots after the engine got worked in, the engine speed being 420 r.p.m. using a fuel pressure of 3,200 pounds. The cost per hour for fuel and lubricating oil is said to have worked out at 15 cents compared with \$1.75 an hour that it cost to drive her with the 47 h.p. gasoline engine she had previously.

The Prince Rupert pilots have ordered a 60 b.h.p. 4-cylinder 2-cycle Fairbanks Morse oil engine for one of their pilot boats.

The Forestry Branch of the Department of Lands has had designs drawn up by T. Halliday for a 42 by 9 ft. launch for the use of the Government log scalers. This boat will be equipped with a 2-cylinder 28 h.p. Vickers-Petters oil-engine. The Forestry Branch this year has begun the installation of oil-engines in new boats, and the replacement of some of the worn out gas engines in older boats with crude oil engines.

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